

APPENDIX A

Analytical Approach, Methods, and Results

1. PURPOSE AND BACKGROUND

1.1 Purpose

The purpose of this appendix is to describe the series of analyses used to estimate the hydrologic and fish survival effects of USBR's proposed action. This appendix describes the methods, analytical approach, and survival modeling results for the information provided in the body of this Opinion.

1.2 Analytical Approach and Background

The analyses conducted for this Opinion covered four areas:

- Hydrologic effects modeling,
- Dam and reservoir passage survival modeling,
- Water temperature effects and water-temperature related survival effects, and
- Total dissolved gas (TDG) effects.

Each of these analyses is described in the sections below. To improve readability, all tables and figures referenced in the text below are located at the end of this appendix.

2. HYDROLOGIC ANALYSIS

2.1 Description of the Reference and Proposed Action Operations

The existence and past operation of USBR's Upper Snake River projects is part of the environmental baseline. Many of the projects have been in place and operating for more than 50 years so their hydrologic effects are included in available hydrologic records. It is difficult to distinguish between the effects attributable to discretionary components versus non-discretionary components of USBR's proposed actions. Therefore, for the purposes of this consultation, NMFS, with the assistance of the USBR, developed a theoretical "reference operation" that does not include operations of USBR's Upper Snake River projects. USBR performed the necessary hydrologic analysis using its MODSIM model (USBR 2004). The principal product of this analysis for our purposes is a 73-year hydrologic record of inflows to Brownlee Reservoir with and without the proposed action (Table A-1 and A-2). The reference operation defines a condition without the effects of the proposed action. It does not, however, describe an operation that USBR could implement, since the USBR is obligated to operate the projects to meet other Congressionally-authorized project purposes, such as flood control and irrigation.

2.2 HYDSIM Modeling of Conditions Downstream From Brownlee Reservoir

To analyze the fish survival effects of the proposed action it was necessary to simulate hydrologic conditions throughout the migratory corridor. The best available tool for this analysis is the HYDSIM model (BPA 1997). HYDSIM simulates the operation of the FCRPS, allowing a wide array of user-selected operating constraints using a 14-period record for each year (a monthly time-step except for April and August, which are divided into two periods each). A 50-year simulated hydrologic record (1929–1978) that assumes the 1990 level of water use, with 14 periods for each year, has been developed for use with this tool.¹

HYDSIM has been the principal tool used to analyze the hydrologic effects of FCRPS operations for over a decade. NMFS requested that BPA use HYDSIM to enumerate the hydrologic effects of USBR's proposed action throughout the FCRPS migratory corridor. For this analysis, all operating constraints identified for operation of the FCRPS projects in conformance with the 2004 FCRPS UPA (Corps et al. 2004) and 2004 FCRPS Biological Opinion (NMFS 2004) were employed (Table A-3).² All FCRPS project operations were allowed to float (operate within those defined constraints) under both the reference operation and the proposed action simulations in order to isolate the effects attributed to the proposed operation of the USBR's Upper Snake River projects. USBR's MODSIM model inflows to Brownlee Reservoir for the years 1929–1978 under the reference operation and the proposed action (Tables A-1 and A-2) were used in this analysis.

This entire 50-year hydrologic record was used to define the hydrologic conditions at specific locations (Figures 5-2, 6-1, 6-2, and 6-3), and to estimate the effects of the proposed action on spills. For the remaining analyses, further aggregation of the data was used to facilitate the analysis. The HYDSIM modeling results used to conduct several of the analyses herein are large EXCEL™ spreadsheet files. Data from those files used in our analyses are presented where appropriate. Readers interested in the entire HYDSIM modeling results for this consultation should contact NMFS Hydro Division at 1201 NE Lloyd Blvd, Suite 1100, Portland, OR 97232-1274.

2.3 Aggregating the HYDSIM Data to Facilitate SIMPAS Modeling of Juvenile Survival

The SIMPAS model, used to estimate the FCRPS dam and reservoir passage effects of USBR's proposed action uses the period 1994 through 2003. However, at this time the region does not have a complete hydrologic model (e.g. HYDSIM) for this study period. Thus, to facilitate conducting the SIMPAS analysis, we constructed surrogate hydrologic records for the years 1994 through 2003 at Lower Granite Dam, McNary Dam, and Bonneville Dam using the HYDSIM model results from the 1929–1978 period for the proposed action and reference operation.

¹HYDSIM does not use raw measured streamflows to drive the model. Instead it uses a modified hydrologic record that reflects streamflows that would have occurred under the 1990 level of water use (Crook 1993).

²Appendix D of the 2004 FCRPS Biological Opinion (NMFS 2004) contains a detailed discussion of the constraints used to define the hydrologic effects of operating the FCRPS as proposed by the action agencies that was used in the HYDSIM analysis. The same constraints were used for this analysis.

The first step in the process was to identify three years in the HYDSIM period of record (1929-1978) with April through July runoff volumes similar to the year of interest for the SIMPAS analysis (1994-2003). This was done by collecting the actual April through July runoff volumes for the years of interest and identifying the years in the HYDSIM period of record with the nearest runoff volume to the subject year, as well as the next higher and next lower years (Table A-4). This comparison was conducted using data from Crook (1993) that have been modified to simulate hydrologic conditions that would exist if the 1990 level of irrigation had been in place throughout the period and flows were unaffected by storage and release patterns of dams throughout the Columbia basin.

For the SIMPAS analysis, discharge data from Lower Granite, McNary, and Bonneville dams were chosen to represent conditions in the lower Snake River, the lower Columbia River, and downstream from Bonneville Dam, respectively. The periods of interest are:

- Spring juvenile migration season
 - at Lower Granite: April 3 - June 20 (79 days)
 - at McNary: April 10 - June 30 (82 days)
- Summer juvenile migration season
 - at Lower Granite: June 21 - Sept. 30 (102 days)
 - at McNary: July 1 - Sept. 30 (92 days)
- Bonneville Dam chum spawning, incubation, and rearing season
 - chum salmon from spawning through incubation, emergence, and outmigration (November 1 through April 15 [166-167 days])

HYDSIM data from the two operating scenarios for Lower Granite and McNary dams for the surrogate years were collated into individual spreadsheets. The monthly or semi-monthly HYDSIM data were weighted in accordance with the number of days from that period in the spring or summer migration seasons and aggregated to create an average seasonal flow. Tables A-4, A-5, and A-6 provide simulated seasonal average flow conditions under the reference operation for Lower Granite, McNary, and Bonneville dams, respectively.³ Tables A-7, A-8, and A-9 provide the same information for the proposed action.

³The seasonal averages for the summer period include data from August and September for the subsequent operating year, because the HYDSIM operating year ends in July, and the migration period extends through the end of September. Hence, if the 1940 operating year is chosen as a surrogate, data from the HYDSIM run for August 1941 become part of the summer average of interest.

3. JUVENILE PASSAGE SURVIVAL ANALYSIS

3.1 The SIMPAS Model

The SIMPAS (simulated passage) spreadsheet model was first developed by NMFS' Hydro Division staff to evaluate potential actions for the 1995 FCRPS Biological Opinion. Since then, it has been modified and used regularly as an analytical tool to evaluate structural or operational measures for their potential to reduce the mortality of juvenile salmon and steelhead at FCRPS projects. In 1999 and 2000, an updated version of the model was used to evaluate the proposed action for the 2000 FCRPS Biological Opinion. More recently, NMFS updated the SIMPAS model to accommodate newly developed passage routes (for example, RSWs and surface bypass routes) and to more accurately account for passage efficiency through spillways and sluiceways.

The SIMPAS model is initiated with a ESU fish unit (1.00) entering the mainstem corridor at its most upstream entry point in the FCRPS (e.g., Snake River fall chinook enter the SIMPAS model at Lower Granite reservoir). The model then applies an estimated pool survival to these fish prior to their reaching the first FCRPS project dam. At the dam, the model assigns the surviving fish to various routes of passage, applies an estimated survival rate for the respective routes of passage, removes the estimated proportion of fish that are transported from a given project (if it is a collector project), and recombines the surviving fish in the tailrace of the project. This process is repeated for each additional FCRPS mainstem Snake and Columbia river hydropower project encountered by the fish on their way to the sea. Fish guidance and survival estimates are typically averages of empirically measured rates through various routes of dam passage (or derived from average fish passage efficiency estimates) or various reservoir pools. When empirically-based estimates are not available, passage parameter estimates are obtained from studies at other similar projects or from best professional judgment.

For each species, model input includes:

- Seasonal average flows and spill levels
- Pool survival estimates including a predation adjustment factor
- Average spill, sluiceway, and bypass guidance efficiency estimates
- Average survival rates through various passage routes and reservoirs

For each species, model output estimates include:

- Proportion of fish transported and left in-river
- Project-specific and system survival estimates
- Fish passage efficiency at each project
- Mortality due to passage through turbines

Details on the SIMPAS model development, fish passage parameters, and its use in estimating juvenile dam and reservoir passage survival through the FCRPS under alternative operating scenarios is fully described in the 2004 FCRPS Biological Opinion (NMFS 2004), Appendix D. Pertinent sections of that discussion are included here, but the interested reader is encouraged to review the complete write-up in NMFS (2004) Appendix D.

http://www.salmonrecovery.gov/remand/final_biop/Appendix_D.pdf

3.2 Use of the SIMPAS Model and the Survival Gap

The SIMPAS model is a useful analytical tool to estimate juvenile fish passage survival under alternative system operations and configurations. However, there are a number of important caveats to the appropriate use of SIMPAS modeling results, including:

- The juvenile survival rates shown in Tables A-11 through A-18 are based on juvenile passage and survival studies only and should not be used to infer the likelihood of adult returns.
- The juvenile survival rates shown, as well as the input passage parameters, are point estimates, i.e., confidence intervals are not calculated or implied.
- The model does not contain a time-step function, so both inputs and outputs are scaled to seasonal averages.
- Where possible, best available scientific data from several years of studies were averaged, however, in some cases data from only one year of study were available. In such cases, the best available scientific data from the single year was used.
- Best professional judgment was used to develop some of the passage parameters, e.g., in some cases, fish passage data gathered at one dam during a single passage season were applied to several other similar hydrosystem projects or to future system configuration alternatives.

The reach survival data for Snake and Columbia River reaches, available for initial setup and calibration of the SIMPAS model and for estimating reservoir effects, use PIT-tag data collected between 1994 and 2003. These years represent a wide range in flow and environmental conditions, from one of the highest flow years (1997) to one of the lowest flow years (2001) on record (Table A-4). In several years, reach survival data were extrapolated from some of the FCRPS Snake River projects (on a per-mile basis) to the entire system. The reach survival estimates are roughly classified by the volume of runoff during the year in which the data were collected. These survival estimates provide a general sense of the between-year variation observed in the last 10 years, which encompass a range of flow and environmental conditions similar to the 50-year HYDSIM flow record.

The relative difference in survival between the reference operation (environmental baseline) and the USBR's proposed action, expressed as a percent, is termed the survival gap and one of the principal characteristics considered in our analysis of effects (Tables A-11 to A-18)

3.3 Results of the Gap Analyses

The differences in annual survival identified by the SIMPAS analysis represent the juvenile survival effects of passage through the mainstem FCRPS projects attributable to the USBR's

proposed action. Two different gap analyses were conducted, one to measure the near-term (2005) survival gap and a second to measure the long-term (post-2014) survival gap.

The annual SIMPAS survival results and survival gaps are presented in Tables A-11 through A-18. The survival gaps are graphically depicted in Figures A-1 through A-12.

4. WATER TEMPERATURE EFFECTS

4.1 Water Temperature Modeling

Two water temperature models were used to define the proposed action's effects on water temperatures in the Snake River and Columbia Rivers from the head of Lower Granite Reservoir to McNary Dam. These were the RBM 10 model developed by the Environmental Protection Agency (EPA) (Yearsley 1999), and CE-QUAL-W2, a broad spectrum water quality model developed by the U.S. Army Corps of Engineers (Corps) and applied to the Lower Snake River to estimate water temperatures.

RBM 10 is a one dimensional mathematical model which predicts average daily temperatures at specific locations along the lengths of the Columbia and Snake Rivers, but averaged across the width and depth of the rivers (i.e. bulk average). Key elements of the model include a twenty-one year database of temperature and climate data. The model is based on the energy budget method and uses an efficient numerical solution technique that simplifies the characterization of model uncertainty. The energy budget method accounts for the exchange of heat with the atmosphere and the input of advected thermal energy from major tributaries and point sources (Yearsley 1999).

The Corps' CE-QUAL-W2 model is a hydrodynamic two-dimensional heat-budget model that the Corps has been calibrated to estimate Snake River water temperatures at the tailrace of Lower Granite Dam.

Both analyses considered the impacts of the reference operation and USBR's proposed action during high (1997), average (1995), and low (2000) flow conditions. For this modeling effort the SIMPAS surrogate year Brownlee outflows (Appendix A, Section 2.3) for 1995, 1997, and 2000 were combined with actual daily flows from major tributaries to create a daily flow record for each year modeled under the two scenarios. Both models produced mean daily water temperatures (Figures A-13 through A-24). These data were aggregated by month to describe water temperature conditions in Section 5, Environmental Baseline and Section 6, Effects of the Proposed Action. Daily water temperature data from both models was used to estimate the number of days during the spring migration season that water temperatures at Lower Granite Dam would exceed 13°C (Table 6.2.2.1).

4.2 Water Temperature and Flow Effects on Juvenile Fall Chinook Survival

We assessed the effects of the reference operation and proposed action scenarios on Snake River juvenile fall chinook survival to Lower Granite Dam tailrace (Tables 6-5 and 6-6) using a model developed by Connor et al (2003). Connor et al. (2003) determined that flow and temperature

explained about 92% of the observed variability in cohort survival from the point of release to the tailrace of Lower Granite Dam and developed a linear multiple regression model using these two parameters. Cohort survival generally increased as flow increased, and decreased as temperature increased (Connor 2003). This model estimates subyearling Snake River fall chinook survival from their point of release in the free-flowing Snake River to the tailrace of Lower Granite Dam. The model equation is:

$$\text{Cohort survival} = 140.82753 + 0.02648 \text{ Flow (cms)} - 7.14437 \text{ Temperature } (\text{°C})$$

Based on the regression model developed, survival is predicted to change by approximately 3% with each change of 100 m³/s in flow when temperature is held constant. The change in survival is approximately 7% for each 1° C increase or decrease in temperature when flow is held constant (Connor 2003).

The author (Connors 2005) noted that in applying this model to the range of conditions expected under the two scenarios modeled, we frequently exceeded the limits of the data used to create the model. That is, many data points were extrapolations beyond the statistical limits of the model and thus the validity of such extrapolations is not known. We agree. However, most of these extrapolations are only slightly beyond the range of conditions used to develop the model and we place low emphasis on these extrapolated results in developing our conclusions.

5. TOTAL DISSOLVED GAS EFFECTS

5.1 Involuntary Spill

Among the effects throughout the migratory corridor under the USBR's proposed action is the reduction in the frequency and magnitude of involuntary spills due to reductions in spring flows in the Snake River. Spill events are noted in the HYDSIM output as "Forced" spill when spill is required by flows in excess of powerhouse capacity, or "Bypassed" spill when spills are intentionally made to improve fish survival. Bypass spill or "voluntary spill" is managed in accordance with spill caps developed by the Corps to avoid creation of excessive total dissolved gas concentrations in downstream waters (Table 6-4). Involuntary spills are caused by high flow conditions and can exceed these limits up to the hydraulic capacity of the spillways. To analyze the effects of reducing the magnitude and frequency of involuntary spills under the proposed action, we examined the number of times the HYDSIM "Forced" spills would exceed the specified spill cap at three key projects (Lower Granite, Lower Monumental, and McNary dams). These projects were selected because the spill caps are relatively low and high spills are known to cause excessive TDG concentrations. The HYSIM "Forced" spill tables and the frequency that those spills would exceed the specified spill caps under the reference operation and the proposed action are shown in Tables A-19 through A-24. The results are summarized in Table 6-4, Section 6.2.3.1.

LITERATURE CITED

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Tables and Figures

Table A-1. Estimated inflows to Brownlee Reservoir (cfs) under USBR's proposed action. Source: USBR 2004, Flow summary for BiOp.xls

YEAR	October	November	December	January	February	March	April	May	June	July	August	Sept
1928	13378	18179	17881	21034	15848	32449	28878	47396	23286	12970	11893	11878
1929	12622	16666	13592	16323	11453	20181	19698	20263	18849	11643	11216	9954
1930	11823	14811	14679	10448	16124	14580	16281	14311	11711	11280	10551	9515
1931	11979	12806	12087	11862	10978	14189	13391	10537	8059	8095	6911	8140
1932	10206	12763	11836	11608	8184	20215	27663	27144	24962	12542	10191	10463
1933	12506	15958	14163	11882	11569	13796	16843	18681	28234	11571	10853	10576
1934	12133	15525	15147	14552	13163	12799	13523	9883	9119	8430	6736	7714
1935	9992	12187	11469	11697	11486	11968	19251	16194	15275	10740	9467	9753
1936	11954	14795	13403	12648	13734	10771	34318	26786	20504	11220	11405	11128
1937	12052	15009	13942	10754	11241	10736	17971	14787	12204	9055	8012	9353
1938	12670	14759	17015	16922	18317	24087	41790	41149	30147	16941	12132	12120
1939	14322	16364	14980	14579	13580	22460	28706	19942	12113	10557	7586	9548
1940	13039	13066	12348	16445	20361	23778	27822	21094	15050	10684	9052	11071
1941	14629	15081	13973	14089	16657	19363	18228	19357	20923	11700	11521	11710
1942	13318	15841	16694	13987	16001	11799	31595	21462	25879	12723	11306	11663
1943	14183	17163	17725	28419	31613	41082	71701	34873	32500	23997	13322	14124
1944	17097	21830	20147	17876	16208	15429	15785	14486	17253	11640	10718	10637
1945	12964	14818	12728	13049	17120	14013	15158	28947	26678	12946	11282	12297
1946	14052	17548	19980	21838	17001	35071	54522	39690	22120	13572	12618	12809
1947	14559	16303	17556	19071	20477	23769	24058	31033	24049	12477	12101	11973
1948	14062	16234	15529	17707	17748	16889	22524	33687	36869	13723	12107	11780
1949	14153	15479	14184	12411	15749	23007	29315	41001	23285	11933	11830	11178
1950	13362	14470	12691	17182	19758	27769	33387	27619	30145	17025	11501	12638
1951	15692	22248	22087	26058	27420	27679	45483	36288	25121	13815	12732	12416
1952	16217	21729	21210	24660	22510	16787	81463	67572	35591	16496	12067	12364
1953	14125	15582	14434	21362	19496	18239	25764	30017	40378	16510	11956	13038
1954	14940	16307	15469	16763	17810	19842	27777	30775	21678	13452	12308	11551
1955	13604	16046	14522	13783	13262	12614	16807	18214	20367	12351	10850	9927
1956	12697	14488	21560	28491	25950	31107	45518	39537	39020	13710	12960	12841
1957	15896	17222	16368	18888	25396	30875	36178	52915	33062	13000	12153	12875
1958	15368	15679	15563	16876	24854	19154	40892	52702	28923	13394	12856	12494
1959	13217	14394	13404	13502	13655	12229	17852	16835	22433	11353	11753	13555
1960	14656	14824	13843	11408	14678	19942	25025	17184	19114	10499	9870	10002
1961	12649	14286	12097	11149	15541	13656	12643	13302	13867	8843	7458	8822
1962	12833	12383	11479	12866	18630	14818	33940	26754	21980	11512	11182	10981
1963	15265	17402	17267	14073	22378	13385	17846	22824	28741	12275	11197	10893

YEAR	October	November	December	January	February	March	April	May	June	July	August	Sept
1964	12619	15351	14100	11709	11226	13395	26251	25231	38072	12567	11792	12363
1965	13752	15388	26391	29609	38805	30978	46027	40161	35936	17979	13674	13258
1966	16058	18226	17463	19315	15877	17282	20046	17267	12914	10070	7866	9392
1967	13482	13347	12751	19401	18592	16902	17106	25081	36432	13814	11407	11807
1968	13982	15604	14264	17847	20816	18292	11267	17048	20832	10974	13502	10779
1969	13515	16250	14631	22814	19380	16045	51215	48523	25059	12893	12276	12825
1970	13845	13642	12392	25776	20075	21739	17838	36783	37541	16658	12320	14467
1971	14581	17128	15996	39522	34457	35335	49752	55380	44250	22296	12632	13134
1972	20768	24028	19776	35388	28814	64610	37054	43350	45286	15554	13249	14872
1973	16424	22642	21846	24439	20364	19351	20721	24782	17592	10837	10683	12373
1974	14275	19881	19317	35713	27322	43371	53364	40503	44206	17731	12635	13169
1975	16210	17561	17733	25977	23568	25719	30192	48157	45926	25034	14818	13921
1976	19203	21421	24116	25285	22958	30090	46864	45684	34257	13254	15299	14891
1977	14541	20681	16470	15426	14380	12380	8906	8780	8019	7735	6322	8626
1978	10930	12166	15076	16120	19394	22546	30812	32586	21306	14805	11537	14358
1979	12950	13929	13663	17882	19444	22779	20623	25178	16375	10654	10036	10382
1980	12201	12510	11297	17496	18832	18347	30194	36421	31219	13106	10737	14057
1981	13298	15579	18268	16980	20979	16577	20548	18652	24065	11149	11392	11807
1982	13480	14445	16776	21645	39213	37427	47350	50758	34095	23487	12920	15033
1983	22655	22254	23897	37882	35165	59696	45092	50340	42257	21027	16827	14739
1984	22088	26858	25421	34227	29858	47743	61402	67252	57980	20589	17240	17868
1985	19105	26695	20433	21200	20347	22145	46914	35157	16905	11846	11985	13830
1986	14494	13843	11059	23965	48843	58757	53862	40528	35885	14621	12231	14609
1987	15081	20448	17241	21183	17673	16692	14022	12076	11633	9948	8384	10052
1988	10902	11870	11384	11105	11585	11437	12551	11234	11111	7971	7074	9150
1989	11101	12229	11057	11717	12099	26593	36939	24023	16503	10733	11705	11631
1990	12949	14405	12730	11353	10607	14253	15043	13331	13987	9873	9333	9867
1991	11714	12186	9711	10911	11143	10621	10742	13910	12214	9413	7147	10022
1992	11085	13826	12521	10119	12689	11149	10390	8592	7748	6423	5350	6864
1993	9128	10751	9958	11200	10839	26468	31432	40457	23661	12542	11701	10789
1994	12720	13084	12641	13525	12670	13234	13981	12746	9241	8128	7279	8575
1995	11006	11149	11361	17260	20614	24500	27609	37139	33725	16898	11221	12388
1996	14609	15748	22069	27071	35540	36012	49964	44014	28583	14961	12771	13393
1997	14927	15797	20579	48543	42377	43719	53665	54026	49078	19958	16113	14195
1998	22090	19935	17586	28997	23064	27520	28725	56990	42463	16850	12297	13649
1999	14765	19139	19216	26187	26317	41302	44420	40254	41274	14352	12754	13041
2000	14300	14546	14109	20236	23409	22535	30585	20324	13768	11460	11439	12441
Averages	14097	16230	15868	19333	20072	23398	30453	30520	25766	13327	11255	11814

Table A-2. Estimated inflows to Brownlee Reservoir (cfs) under the reference operation. Source: USBR 2004, Flow summary for BiOp.xls

YEAR	October	November	December	January	February	March	April	May	June	July	August	Sept
1928	19874	28744	25497	25062	18798	39028	34184	69937	31186	8880	5882	8409
1929	13852	21386	16835	17616	12763	26410	26956	31886	25764	6449	4767	6395
1930	11459	18373	19605	14554	22526	21071	24189	24556	13693	6017	5494	7174
1931	14260	18428	16935	16024	15873	20214	14678	12720	7501	5013	4670	6284
1932	12908	16606	16206	15069	11684	30111	39361	52068	40171	8495	4541	6900
1933	10630	19530	16733	16806	15512	19362	26611	28798	41416	7050	4804	6968
1934	9601	18013	18901	20195	18935	20629	17409	11959	8064	4971	4337	5782
1935	12829	16791	15873	15209	15604	17541	31858	27582	25355	5845	4370	5935
1936	9039	17583	15784	17167	18889	19001	53261	58104	31324	6150	5232	7354
1937	9439	17697	17050	14252	15491	17414	22979	22482	13987	5814	4965	6858
1938	15095	19943	24938	19539	19078	30002	50443	60746	46106	13602	6264	7962
1939	14357	21462	19525	17237	15368	31218	36459	29966	9733	5764	4803	7046
1940	15899	17740	17667	17833	23402	33381	33364	25751	14416	5834	4750	8550
1941	17710	21152	19555	18790	23918	26961	22313	24463	21884	7568	6123	8474
1942	12947	21940	24630	19067	21374	18860	48965	35098	34060	8598	5159	7961
1943	11973	23798	24903	29059	28121	38954	79263	53034	54821	25560	7779	9742
1944	14636	26095	19977	17404	18496	18962	19757	18802	25172	6996	5081	7194
1945	10709	20567	17973	18756	25209	21522	24784	45776	38673	9601	5485	8162
1946	14640	22111	23269	21804	17649	36515	61121	54942	29969	8686	5916	9454
1947	16643	24552	25789	18309	23941	25132	27640	45929	31952	8070	5600	8422
1948	14457	21608	20811	20890	20213	19702	29179	46470	44971	8451	5468	8011
1949	13797	20340	18579	16329	19777	30620	41232	54650	26846	6232	5067	7280
1950	13951	20933	18440	18760	22222	28593	37939	40698	49730	17593	5720	8077
1951	17164	24310	23846	19977	31192	25253	52292	55972	36155	9459	6565	8435
1952	18365	23170	24719	20663	19703	16901	89116	89856	44417	12073	5637	8711
1953	12788	19335	19404	26950	22987	21602	30619	33841	56735	12860	5676	8052
1954	12047	20890	19794	20282	22513	23254	31547	44505	27205	9258	5798	7764
1955	13016	20072	18144	17317	16197	17086	21886	29250	27118	8034	5150	6899
1956	11778	21133	32596	30022	21270	30822	48326	64839	55618	8932	6399	8243
1957	15681	22648	22043	17765	27367	34942	35534	69567	48806	7935	5779	8235
1958	14666	20021	21103	19081	30516	22131	43985	70212	33690	7618	6391	8549
1959	10987	20433	20588	19922	19753	18200	24533	25209	28902	6299	5314	10274
1960	16464	19289	17916	16463	20208	30602	29583	22916	19104	5086	5121	6977
1961	14727	20372	16744	14841	21681	20372	14774	17892	14520	4496	3849	6530
1962	17210	18570	16852	15130	27178	21358	41510	42823	32844	6759	5193	7093
1963	15068	21219	21057	16188	32004	17558	22236	32288	37016	7355	4743	7473

YEAR	October	November	December	January	February	March	April	May	June	July	August	Sept
1964	10762	20052	17562	16931	15724	19209	32931	38287	51042	8804	5410	8018
1965	10993	20062	37438	27753	35403	25472	49414	58846	59958	18999	8299	8878
1966	13251	20440	18199	19376	17303	21267	24330	26701	10607	4961	4710	6641
1967	14940	19115	18518	20358	19054	19247	18529	35793	53532	9881	5004	7242
1968	13556	20150	17926	17154	24259	21808	15402	23060	30078	5369	7721	7418
1969	13097	21720	19293	28061	21587	20222	65087	61912	29532	7584	5748	9057
1970	14416	19053	18258	32406	23237	22772	18173	47310	55392	12438	6212	10123
1971	14142	24346	20571	35135	25768	28381	48029	78173	72885	22846	6000	8484
1972	17424	24847	22816	26920	21614	62523	40373	61154	69084	10731	7183	10297
1973	19095	23700	23746	25209	21839	24158	26774	35724	19902	6198	5723	9218
1974	15364	28651	26392	31780	19480	39337	51275	57818	74131	16297	6845	8322
1975	15844	20705	20080	19932	23009	28073	30768	58748	69962	27258	7721	9147
1976	18848	22458	25699	22595	21409	25948	48705	67141	43625	9117	9727	11474
1977	16181	19282	18799	17480	17427	15758	8451	8217	6479	3827	3389	6138
1978	14048	17418	23774	21750	23429	31840	40975	49587	42437	12282	5719	10022
1979	11892	17594	16397	17673	21850	27880	25902	38255	19626	5224	5138	7155
1980	12239	16338	16763	23181	25785	21954	34029	51497	39857	9546	5096	11134
1981	13066	19982	23363	20508	25251	21959	26023	28641	26411	6067	5211	8296
1982	13153	20731	25807	19531	43864	34712	44341	69200	61948	28882	7019	10868
1983	19523	23078	26796	27447	27133	57747	45736	70009	69339	22857	9667	10316
1984	19749	28745	27589	26807	23505	43745	63789	86951	78837	21655	7544	11439
1985	18925	26299	23194	21262	21170	25440	53145	46113	19244	6216	5446	10893
1986	16723	20807	18510	17083	49745	60562	57299	52144	61157	9251	6091	10647
1987	18117	22015	19906	19613	21113	23364	17404	14220	8218	5985	5383	7357
1988	12854	17992	17244	16589	17165	18001	18341	14662	10429	4436	3995	6600
1989	12021	17786	16532	15804	16791	43262	47035	39671	23270	5417	5623	8004
1990	13504	18163	16598	17201	15964	21135	22482	16150	15505	4903	4607	6571
1991	11867	17003	13945	16074	16538	17488	14716	30093	20026	5558	4188	7150
1992	8762	18136	16433	14897	18688	17493	11630	9755	4898	4444	3611	5427
1993	10822	14807	15147	15665	15099	46611	42724	63571	39606	8468	6498	7277
1994	12764	15596	16757	17144	16669	18498	15989	17303	6432	4198	3875	5715
1995	14032	16022	17375	22112	29323	34300	33013	52888	54227	15377	5519	8044
1996	14076	20303	25257	20736	31468	31939	47958	61124	56501	10376	6337	8807
1997	13716	22368	27940	45897	30766	37110	52005	84409	70352	18548	7542	10216
1998	19055	21012	19711	23441	21372	31072	32252	73944	53491	12737	5820	9557
1999	16996	20824	20886	22633	23059	38476	42066	56252	63051	10322	6699	8135
2000	12738	19936	19648	20991	27125	26856	36979	30608	13165	5615	4923	8987
Averages	14236	20608	20564	20623	22293	27355	35534	43719	36071	9672	5687	8174

Table A-3. FCRPS system operating constraints used in the HYDSIM models for this consultation.

FCRPS Project	Operating Criteria
Libby	<ul style="list-style-type: none"> • Use VARQ flood control criteria. • Use variable Dec. 31 flood control curve based on runoff forecast. • Minimum flow = 4 kcfs. • Maintain minimum flows for bull trout. • Provide tiered volumes for listed KR white sturgeon spawning/recruitment. • Operate within hourly/daily ramp rates for bull trout. • Operate to achieve 75% chance of reaching URC elev. by April 10. • Refill by about June 30 each year. • Draft to meet salmon flow objectives during July-August with draft limit of 2439 ft. by Aug. 31. • Provide even or gradually declining flows during summer months (minimize double peak). • Negotiate with Canada annually to try to implement a storage exchange. • Limit spill to avoid exceeding Montana State TDG standards of 110%.
Hungry Horse	<ul style="list-style-type: none"> • Use VARQ flood control. • Min Q = 400-900 cfs at site, w/ sliding scale min Q of 3200-3500 cfs at Col. Falls. • Maintain minimum flows for bull trout. • Operate within hourly/daily ramp rates for bull trout. • Operate to achieve 75% chance of reaching URC elev. by April 10 • Refill by June 30 each year. • Draft to meet salmon flow objectives during July-August with draft limit of 3540 ft. by Aug. 31. • Provide even or gradually declining flows during summer months (minimize double peak). • Limit spill to avoid exceeding Montana State TDG standards of 110%.
Albeni Falls	<ul style="list-style-type: none"> • Use standard flood control. • Draft to elev. 2051 ft. by Nov. 30 annually.
Grand Coulee	<ul style="list-style-type: none"> • Use standard flood control. • Operate to achieve 85% chance of reaching URC elevation by April 10. • Refill by June 30 each year. • Draft to meet salmon flow objectives during July-August with variable draft limit of 1278-1280 ft. by August 31. • Incl. irrigation withdrawal pumping into Banks Lake; operate Banks Lake up to 5 ft. from full pool during August to meet flow target.
Chief Joseph	<ul style="list-style-type: none"> • Operate as run-of-river project. • Install spillway flow deflectors.
Dworshak	<ul style="list-style-type: none"> • Use standard flood control; shift system FC to GCL in below average water years, if possible. • Minimum flow = 1.3 kcfs. • Refill by June 30 each year. • Draft to meet salmon flow objectives during July-August with draft limit of 1520 ft. by Aug. 31.

FCRPS Project	Operating Criteria
	<ul style="list-style-type: none"> • Regulate outflow temps to meet WQ temperature std. at LWG. • Maximum project discharge for salmon flow augmentation to be within State of Idaho TDG water quality standards (14 kcfs).
Lower Snake River dams (LWG to IHR)	<ul style="list-style-type: none"> • Operate at MOP elev. from April 10 until small number of juvenile migrants are present, except at Lower Granite operate at MOP until TMT determines the Lower Granite forebay has cooled enough, generally after October 1. • During the spring: spill 20 kcfs at Ice Harbor and Lower Granite; spill to the gas cap at Little Goose and Lower Monumental. • During the summer: spill 20 kcfs at Ice Harbor; provide no spill at Lower Granite, Little Goose, and Lower Monumental. • Collect fish and transport at LWG, LGS and LMN; provide fish spill in years when flows >85 kcfs during spring months. • Operate RSWs with 24-hour spill at Lower Granite, Little Goose, Lower Monumental (in spring only) and at Ice Harbor Dam (when flows are ≥85 kcfs).
Columbia River dams (MCN to BON)	<ul style="list-style-type: none"> • Operate JDA pool at MIP from April 10 thru Sept. 30. • Spill 75 kcfs during the day and spill to the gas cap at night at Bonneville April through August. • Spill 40% at The Dalles April through August. • At John Day spill 60% at night during the spring (April-June) and 30% 24-hrs. during the summer (June-August). • At McNary, spill to the gas cap at night during the spring and provide no spill during the summer. • Operate corner collector at Bonneville Second P.H. April through August. • Operate RSWs with 24-hour spill at McNary (in spring only) and John Day dams.

Table A-4. April through July runoff volumes at Lower Granite Dam for 1994 through 2003 and years between 1929 and 1978 with similar runoff volumes. Source: Crook 1993

SIMPAS Study Year	Observed Apr-Jul Runoff Volume, in Maf	Historical Runoff Years	Historical Apr-Jul Runoff Volume, in Maf	3-year average Apr-Jul Runoff Volume, in Maf
1994	11.3	1934	12.52	
		1973	12.21	11.83
		1931	10.77	
1995	21.0	1946	22.01	
		1933	21.00	21.30
		1959	20.93	
1996	28.4	1975	29.26	
		1976	28.48	28.49
		1957	27.72	
1997	33.5	1974	35.68	
		1971	34.59	33.94
		1943	31.56	
1998	23.7	1951	24.11	
		1949	23.78	23.83
		1953	23.61	
1999	25.8	1950	27.20	
		1964	26.10	25.92
		1969	24.47	
2000	17.2	1942	18.49	
		1961	17.05	17.13
		1940	15.86	
2001	10.3	1973	12.21	
		1931	10.77	10.54
		1977	8.64	
2002	19.0	1955	19.93	
		1960	18.97	19.23
		1963	18.78	
2003	16.7	1961	17.05	
		1940	15.86	16.10
		1968	15.40	
10-yr. mean	20.7			
61-yr. mean	21.4			

Table A-5. Lower Granite Dam monthly and period average discharge for surrogate years under the reference operation. Data from BPA HYDROSIM Model run: FRIII_USNBIOP04-NOIRR.XLS dated 02-19-05.

Lower Granite Reference Operation

Data from: BPAHYDSIMstudyFRIII_USNBIOP04-NOIRR.XLS dated 01-30-05

SIMPAS Study year	HYDSIM Surrogate year	Total discharge in cfs													
		AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
1994	1934	18323	14297	17379	20169	22595	55557	60274	47512	55371	93798	101286	60921	29193	27149
	1973	19317	15034	22966	31716	24772	38780	40912	35972	39811	45608	48941	82116	57880	32223
	1931	16796	13012	17115	24871	16654	24645	25391	25809	35862	56355	43267	65432	32916	25469
	average	18145	14114	19153	25585	21340	39661	42192	36431	43681	65254	64498	69490	39996	28280
1995	1946	28585	18828	27451	24923	23945	36895	41484	38996	69495	107449	137789	130944	86053	42870
	1933	27669	17827	22338	20700	22016	27720	29287	28946	39187	66859	91573	88613	155535	44985
	1959	27338	20930	24708	23524	29251	49968	60547	53615	52194	79595	72141	93364	121408	44833
	average	27864	19195	24832	23049	25071	38194	43773	40519	53625	84634	100501	104307	120999	44229
1996	1975	36637	32742	29120	26019	20138	29480	32892	45376	61248	57388	79213	127887	195045	92116
	1976	38800	32027	30548	35546	29167	63847	58167	52522	59838	135289	114623	174106	125956	54560
	1957	27689	19142	24234	27967	24825	36705	28758	43221	64303	102106	99576	198208	137250	43838
	average	34375	27970	27967	29844	24710	43344	39939	47040	61796	98261	97804	166734	152750	63505
1997	1974	36637	32742	29120	25577	38448	49385	85183	59220	91204	115396	144225	160533	225642	66924
	1971	34508	29526	30430	27805	28798	36388	64584	80405	63174	109083	111435	198220	192792	68587
	1943	37678	32030	30790	21485	25782	39677	47590	56163	75239	168811	182090	128880	153081	82571
	average	36274	31433	30113	24956	31009	41817	65786	65263	76539	131097	145917	162544	190505	72694
1998	1951	31347	21111	24389	32789	33594	48356	47971	72668	57927	116632	118398	136584	104340	52640
	1949	24559	17355	22577	26037	22671	30382	28169	41075	78622	112170	127585	167518	87931	37049
	1953	32861	29397	28730	22902	18241	28847	46506	53268	45755	54393	91083	99295	160062	58706
	average	29589	22621	25232	27243	24835	35862	40882	55670	60768	94398	112355	134466	117444	49465
1999	1950	35805	30090	29641	25930	23729	31877	32369	54010	79494	101818	106272	119480	156520	65484
	1964	34015	30235	31954	22404	21926	28589	28624	28678	34994	96183	85853	116656	176490	52749
	1969	26039	19376	24478	30017	31610	35532	66999	51291	57125	122708	137481	159992	91362	42304
	average	31953	26567	28691	26117	25755	31999	42664	44660	57204	106903	109869	132043	141457	53512

2000	1942	25671	17864	23104	27727	29661	50638	39046	38868	34575	93389	109905	96710	99997	48311
	1961	22955	17130	21692	25860	22646	27724	25965	54964	52446	58046	71671	86502	89055	32467
	1940	18995	14273	22623	25453	15745	28312	30269	42641	66924	84898	87931	94953	53204	30124
	average	22540	16422	22473	26347	22684	35558	31760	45491	51315	78778	89836	92722	80752	36967
2001	1973	19317	15034	22966	31716	24772	38780	40912	35972	39811	45608	48941	82116	57880	32223
	1931	16796	13012	17115	24871	16654	24645	25391	25809	35862	56355	43267	65432	32916	25469
	1977	18598	16957	15720	28816	19626	28494	27077	27933	25708	29488	37447	37776	33564	23107
	average	18237	15001	18600	28468	20351	30640	31127	29905	33794	43817	43218	61775	41453	26933
2002	1955	30507	26782	24630	24073	20208	27371	27167	26285	26780	55570	74804	98913	122017	50473
	1960	27306	19012	23473	44244	31759	39017	35913	39635	62069	106072	91202	84172	93083	36853
	1963	26547	19497	24733	34226	29533	42924	34612	68090	39305	54910	56003	106792	111525	47172
	average	28120	21764	24279	34181	27167	36437	32564	44670	42718	72184	74003	96626	108875	44833
2003	1961	22955	17130	21692	25860	22646	27724	25965	54964	52446	58046	71671	86502	89055	32467
	1940	18995	14273	22623	25453	15745	28312	30269	42641	66924	84898	87931	94953	53204	30124
	1968	27670	26021	29494	27780	25180	32048	31784	61576	51380	44679	41970	81632	102731	38982
	average	23207	19141	24603	26364	21190	29361	29339	53060	56917	62541	67191	87696	81663	33858

Spring and summer period averages

SIMPAS Study Year	Spring	Spring	Summer	Summer
	Rounded April 3 - June 20	April 3 - June 20	June 21 - Sept 30	Rounded June 21 - Sept 30
1994	60380	60378	23032	23030
1995	104600	104573	39717	39720
1996	138840	138838	51944	51940
1997	161290	161291	59892	59890
1998	119360	119365	41869	41870
1999	126080	126079	47437	47440
2000	86850	86849	31653	31650
2001	50150	50152	22755	22760
2002	91410	91409	38990	38990
2003	78140	78136	31948	31950

Table A-6. McNary Dam monthly and period average discharge for surrogate years under the reference operation. Data from BPA HYDROSIM Model run: FRIII_USNBIOP04-NOIRR.XLS dated 02-19-05.

McNary period average discharge under reference op. Note: April and August are divided into two periods each.

Data from: BPA HYDSIM study FRIII_USNBIOP04-NOIRR.XLS dated 02-19-05

SIMPAS Study year	HYDSIM Surrogate year	Total discharge in cfs													
		AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
1994	1934	135025	115274	89024	118414	162080	242534	306902	247804	186769	278902	298743	274991	164040	183421
	1973	131099	100087	77907	109312	114452	156699	194295	104913	110407	107566	124634	174877	178385	142202
	1931	129513	114164	87492	104895	117676	129615	104381	97589	106110	142790	112043	139303	153278	136574
	average	131879	109842	84808	110874	131403	176283	201859	150102	134429	176419	178473	196390	165234	154066
1995	1946	190542	127206	101204	104399	115726	127377	156662	147745	180990	228368	278049	352469	267600	211257
	1933	200000	181607	101224	100580	116420	150979	200628	183311	112486	158256	202220	250098	393191	290310
	1959	197508	126294	147806	99614	136682	178884	252884	207455	155459	202006	229135	290934	359375	259427
	average	196017	145036	116745	101531	122943	152413	203391	179504	149645	196210	236468	297834	340055	253665
1996	1975	154937	131472	99161	97598	114320	128826	179893	155440	171484	143016	199379	305387	387869	296389
	1976	252854	225338	160455	114831	151262	235917	240803	200582	149714	290542	274891	403223	280499	271722
	1957	138622	107968	89560	112081	122917	158843	170538	121018	145847	239226	236998	399466	375759	181690
	average	182138	154926	116392	108170	129500	174529	197078	159013	155682	224261	237089	369359	348042	249934
1997	1974	200095	190794	104211	98007	111657	183259	319494	264325	219212	282525	339608	412644	507702	321637
	1971	200000	172778	97813	100766	116360	117491	217942	256316	165492	223999	269741	451420	411281	251355
	1943	192526	142162	94108	101205	112102	151558	189495	169360	173726	329654	333271	334160	312400	245450
	average	197540	168578	98711	99993	113373	150769	242310	230000	186143	278726	314207	399408	410461	272814
1998	1951	200000	149261	99725	118193	157309	200109	245514	256313	178005	247844	302237	386084	263281	233757
	1949	134760	107677	81976	110799	120671	135129	150129	142630	203581	191553	293000	363445	269662	145839
	1953	187572	142406	96352	98394	117472	122981	151948	184629	116861	135568	188757	271937	358485	228215
	average	174111	133115	92684	109129	131817	152740	182530	194524	166149	191655	261331	340489	297143	202604
1999	1950	198380	153928	101842	103253	114206	128686	166488	202919	226686	226142	266211	306019	431548	272177
	1964	200000	162493	109473	95651	112850	135415	170043	125146	108099	168488	204167	255385	418251	275670
	1969	163115	104390	89344	124649	146100	159694	241395	190301	153277	308223	318501	409342	284322	200419
	average	187165	140270	100220	107851	124385	141265	192642	172789	162687	234284	262960	323582	378040	249422

2000	1942	188709	142762	95212	107072	115446	183523	209068	125384	100794	158959	208915	218026	272116	205780
	1961	147351	127326	84759	102176	125580	135196	175788	186312	169708	200344	233207	269174	398679	179027
	1940	130603	109076	88272	107565	117690	126890	146028	120632	166999	176290	208091	214240	191808	143678
	average	155554	126388	89414	105604	119572	148536	176961	144109	145834	178531	216738	233813	287534	176162
2001	1973	131099	100087	77907	109312	114452	156699	194295	104913	110407	107566	124634	174877	178385	142202
	1931	129513	114164	87492	104895	117676	129615	104381	97589	106110	142790	112043	139303	153278	136574
	1977	131886	108172	80760	109425	116754	126344	147030	97068	92049	101076	102267	144005	144291	112617
	average	130833	107474	82053	107877	116294	137553	148569	99857	102855	117144	112981	152728	158651	130464
2002	1955	200000	173317	96872	115284	141798	151735	132306	103273	100573	126882	148568	212797	388642	299954
	1960	179587	111139	90202	173563	173191	193447	192559	133862	151481	299860	275740	251563	269979	206286
	1963	185117	138059	95731	113043	138373	173728	178713	157769	137303	140119	162526	261941	248223	200000
	average	188235	140838	94268	133963	151121	172970	167859	131635	129786	188954	195611	242100	302281	235413
2003	1961	147351	127326	84759	102176	125580	135196	175788	186312	169708	200344	233207	269174	398679	179027
	1940	130603	109076	88272	107565	117690	126890	146028	120632	166999	176290	208091	214240	191808	143678
	1968	195431	151213	122204	107297	128219	146751	185471	182182	160608	114728	164190	215124	287704	235581
	average	157795	129205	98412	105679	123830	136279	169096	163042	165772	163787	201829	232846	292730	186095

Spring and summer period averages

	Spring	Spring	Summer	Summer
SIMPAS Study Year	Rounded April 10-June 30	April 10-June 30	July 1 - Sept 30	Rounded July 1 - Sept 30
1994	180250	180253	120173	120170
1995	294620	294619	180726	180730
1996	326750	326748	178811	178810
1997	379040	379036	185640	185640
1998	299260	299260	150030	150030
1999	325880	325882	171636	171640
2000	246300	246299	135858	135860
2001	145020	145021	110740	110740
2002	251720	251725	165248	165250
2003	244030	244028	142995	142990

Table A-7. Bonneville Dam monthly and period average discharge for surrogate years under the reference operation. Data from BPA HYDROSIM Model run: FRIII_USNBIOP04-NOIRR.XLS dated 02-19-05.

Bonneville chum spawning/incubation period average discharge under reference op.

Data from: BPA HYDSIM study FRIII_USNBIOP04-NOIRR.XLS dated 01-30-05

SIMPAS Study Year	HYDSIM Surrogate Year	Total discharge in cfs													
		AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
1994	1934	210703	189864	109551	125377	172708	288358	349568	270879	211491	300036	333755	290951	178814	193511
	1973	175334	126304	95829	112631	125000	137609	154135	139318	190394	193855	232373	229356	204984	152944
	1931	152538	118408	93064	110038	125000	134872	110332	104734	117792	160743	132890	153306	166607	147291
	Average	179525	144859	99481	116015	140903	186946	204678	171644	173226	218211	233006	224538	183468	164582
1995	1946	141369	121002	90221	108683	125000	141833	176434	161043	200836	242723	306796	373189	286418	223028
	1933	178200	145968	104717	106217	127989	163263	214475	193145	127899	173697	227623	268985	421671	305632
	1959	145688	129353	97208	103398	150418	194700	273451	223525	171722	215991	245798	299451	364257	269351
	Average	155086	132108	97382	106099	134469	166599	221453	192571	166819	210804	260072	313875	357449	266004
1996	1975	207676	197496	110945	103523	125000	141513	203826	172557	191003	156686	222661	316052	391875	305403
	1976	162284	137357	106117	120796	165401	259167	266065	217386	168509	305640	292635	406141	281064	275776
	1957	201929	155626	106060	117822	132031	174650	181192	132679	175211	264163	263429	414785	401627	190028
	average	190630	163493	107707	114047	140811	191777	217028	174207	178241	242163	259575	378993	358189	257069
1997	1974	133889	104386	84926	104018	131294	214872	354242	283128	238863	300154	360307	420994	506023	327032
	1971	134666	106387	90094	104428	125000	130175	251357	274782	179449	240684	286713	471110	427267	254868
	1943	197523	148722	102238	106326	125000	169254	207109	189875	194116	357444	378886	353072	333691	259320
	average	155359	119832	92419	104924	127098	171434	270903	249262	204143	299427	341969	415059	422327	280407
1998	1951	208603	160791	109359	126263	174620	223722	270588	289210	199225	273019	331767	407879	278969	245253
	1949	208483	183630	114955	116175	131251	147439	157447	160796	228039	207865	326093	388488	287268	156241
	1953	176922	118574	97624	103284	125000	131290	182754	209615	133069	152225	209477	290316	381208	242205
	average	198003	154332	107313	115241	143624	167484	203596	219874	186778	211036	289112	362228	315815	214566
1999	1950	143804	114644	89630	108994	125000	141835	178006	223020	254414	245939	294618	325011	456668	286603
	1964	190798	144453	101304	98435	125000	146087	188824	139438	120375	179532	219249	262145	427840	297072
	1969	199620	151887	125987	129042	159687	172068	258915	203393	168732	328578	348153	291996	292534	202631
	average	178074	136995	105640	112157	136562	153330	208582	188617	181174	251350	287340	293051	392347	262102

2000	1942	129376	123244	106073	112850	125143	207538	221695	142773	112942	173199	233119	232279	288243	215986
	1961	185224	117834	96103	108739	142449	148609	193230	224430	196772	214415	251139	274637	412648	195304
	1940	175334	126304	95829	112631	125000	137609	154135	139318	190394	193855	232373	229356	204984	152944
	average	163311	122461	99335	111407	130864	164585	189687	168840	166703	193823	238877	245424	301958	188078
2001	1973	214004	203831	107190	114909	125000	172350	208046	114852	122003	116682	139255	182802	184321	145029
	1931	152538	118408	93064	110038	125000	134872	110332	104734	117792	160743	132890	153306	166607	147291
	1977	255004	227959	166638	115665	125000	136117	156268	103326	99705	110204	116589	150101	151400	116602
	average	207182	183399	122297	113537	125000	147780	158215	107637	113167	129210	129578	162070	167443	136307
2002	1955	237293	207638	159884	121767	151824	162365	142942	114169	109756	139357	167043	227707	402074	316045
	1960	206798	133319	153376	182414	182453	206511	200779	154497	169368	321725	301995	263506	283061	215705
	1963	179599	136169	95371	117860	151957	190877	190352	182191	150542	154341	187252	272408	258084	205813
	average	207897	159042	136210	140680	162078	186584	178024	150286	143222	205141	218763	254540	314406	245854
2003	1961	185224	117834	96103	108739	142449	148609	193230	224430	196772	214415	251139	274637	412648	195304
	1940	175334	126304	95829	112631	125000	137609	154135	139318	190394	193855	232373	229356	204984	152944
	1968	203145	134214	99852	113830	136695	158327	198753	208674	171381	121748	182788	217155	289090	236383
	average	187901	126117	97261	111733	134715	148182	182039	190807	186182	176673	222100	240383	302241	194877

Chum salmon spawning, incubation, and rearing period average flows (November 1 through April 15)

SIMPAS Study year	Chum Flows
1994	179618
1995	179452
1996	186271
1997	212798
1998	186291
1999	180627
2000	166945
2001	130699
2002	168013
2003	168932

Table A-8. Lower Granite Dam monthly and period average discharge for surrogate years under the proposed action. Data from BPA HYDROSIM Model run: FRIII_USNBIOP04 dated 2-19-05.

Lower Granite BiOp base case (Proposed Action) Data from:

FRIII_USNBIOP04.XLS

8/5/2004

Total discharge in cfs

SIMPAS Study Year	HYDSIM Surrogate Years	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
1994	1934	20059	16033	21026	22701	21905	50063	54631	41740	47541	89912	97400	58845	29249	30579
	1973	24277	19994	26121	29045	23714	36880	40142	34497	35004	39555	42888	71174	55570	36862
	1931	18707	14923	20861	22590	15550	15425	21229	20914	29837	55068	41980	63249	32916	27592
	average	21014	16983	22669	24779	20390	34123	38667	32384	37461	61512	60756	64423	39245	31678
1995	1946	35287	25530	30806	24335	19382	33606	41518	38348	68051	100850	131190	115692	78204	47756
	1933	33522	23680	26149	22576	19810	23828	24363	25003	33621	57091	81805	78496	142353	49506
	1959	35827	26409	36010	25754	26142	39950	54127	47517	46223	72914	65460	84990	114939	49887
	average	34879	25206	30988	24222	21778	32461	40003	36956	49298	76952	92818	93059	111832	49050
1996	1975	43684	44178	36893	26385	16994	27133	38937	45935	58894	56812	78637	117296	171009	89892
	1976	44372	42279	35743	35901	28130	62264	60857	54071	63980	133448	112782	152649	116588	54560
	1957	34063	25516	28874	28182	19501	30932	29881	41250	60236	102750	100220	181556	121506	48903
	average	40706	37324	33837	30156	21542	40110	43225	47085	61037	97670	97213	150500	136368	64452
1997	1974	42427	38532	33966	24488	29678	42310	89116	67062	95238	117485	146314	143218	195717	68358
	1971	41140	36158	35080	28244	21775	31624	70691	89094	70128	110806	113158	175427	164157	68037
	1943	43221	37573	35172	23695	19307	32344	46950	59655	77367	161249	174528	110719	130760	81008
	average	42263	37421	34739	25476	23587	35426	68919	71937	80911	129847	144667	143121	163545	72468
1998	1951	39072	32527	28370	31317	31532	46597	54052	68896	60353	109823	111589	116900	93306	53533
	1949	31322	24118	26475	26393	19655	24203	24251	37047	71009	100253	115668	153869	84370	42750
	1953	39141	35677	33716	24239	16229	22192	40918	49777	42392	49538	86228	95471	143705	62356
	average	36512	30774	29520	27316	22472	30997	39740	51907	57918	86538	104495	122080	107127	52880
1999	1950	41586	35871	34202	25341	20120	23367	30791	51546	78670	97266	101720	106401	136936	64916
	1964	40397	36617	36299	24261	19198	23218	23402	24180	29180	89503	79173	103600	163520	53657
	1969	32567	25904	28246	30435	27213	29831	61752	49084	52948	108836	123609	146603	86889	47613
	average	36921	31494	31410	26331	20815	25635	38648	41603	53599	98535	101501	118868	129115	55395
2000	1942	34483	25303	26806	28098	25045	41267	33966	33495	27514	76019	92535	83074	91816	50479
	1961	25413	19588	25695	23782	19597	20138	22273	48824	45730	55915	69540	81912	88402	36310
	1940	23047	18325	25402	22593	15328	18873	28881	39600	57321	79356	82389	90296	53838	34974
	average	27648	21072	25968	24824	19990	26759	28373	40640	43522	70430	81488	85094	78019	40588

2001	1973	24277	19994	26121	29045	23714	36880	40142	34497	35004	39555	42888	71174	55570	36862
	1931	18707	14923	20861	22590	15550	15425	21229	20914	29837	55068	41980	63249	32916	27592
	1977	19920	18279	24685	27176	21025	26165	25023	24886	22330	29943	37902	37776	33564	24411
	average	20968	17732	23889	26270	20096	26157	28798	26766	29057	41522	40923	57400	40683	29622
2002	1955	36207	32482	29613	24661	17460	22513	23633	23350	22308	52538	69725	87877	115266	50762
	1960	32055	23761	26498	42436	29794	32526	30858	34105	51409	101514	86644	78440	93093	42266
	1963	36099	25694	28419	34423	25716	39134	32497	58464	35132	50520	51613	97328	103250	50469
	average	34787	27312	28177	33840	24323	31391	28996	38640	36283	68191	69327	87882	103870	47832
2003	1961	25413	19588	25695	23782	19597	20138	22273	48824	45730	55915	69540	81912	88402	36310
	1940	23047	18325	25402	22593	15328	18873	28881	39600	57321	79356	82389	90296	53838	34974
	1968	33451	31802	32854	28206	22353	26722	32477	58133	47864	40544	37835	75620	93485	44587
	average	27304	23238	27984	24860	19093	21911	27877	48852	50305	58605	63255	82609	78575	38624

Spring and summer period averages

	Spring	Spring	Summer	Summer
SIMPAS Study year	Rounded April 3- June 20	April 3- June 20	June 21 - Sept 30	Rounded June 21 - Sept 30
1994	56870	56873	25897	25900
1995	95120	95116	44069	44070
1996	128110	128111	54751	54750
1997	146400	146401	60361	60360
1998	109110	109107	45453	45450
1999	114820	114819	49102	49100
2000	80210	80205	34993	34990
2001	47430	47426	25882	25880
2002	85170	85166	42408	42410
2003	73960	73963	35333	35330

Table A-9. McNary Dam monthly and period average discharge for surrogate years under the proposed action. Data from BPA HYDROSIM Model run: FRIII_USNBIOP04 dated 2-19-05.

McNary period average discharge. Note: April and August are divided into two periods each.

Data derived from BPA HYDROSIM Model run:

FRIII_USNBIOP04.XLS

SIMPAS Study year	HYDSIM Surrogate years	Total discharge in cfs													
		AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
1994	1934	136761	117010	92670	120946	161390	237040	301259	242032	178939	275016	294857	272915	164095	186851
	1973	136059	105047	81062	106641	114452	153775	193525	103438	105600	101513	118581	163935	176075	146841
	1931	131424	116075	91238	102614	117676	120396	99150	92694	100085	141503	110756	137120	153278	138697
	average	134748	112711	88323	110067	131173	170404	197978	146055	128208	172677	174731	191323	164483	157463
1995	1946	197244	133908	104559	103811	115726	119672	156696	147097	179546	221769	271450	337217	259751	216143
	1933	200583	192400	105035	102456	114213	147088	195704	179368	106920	148488	192452	239981	380009	294831
	1959	200000	136433	151087	101844	133572	168866	246464	201357	149488	195325	222454	282560	352906	264481
	average	199276	154247	120227	102704	121170	145209	199621	175941	145318	188527	228785	286586	330889	258485
1996	1975	162034	138569	103935	97964	114320	123437	185938	155999	169130	142440	198803	294796	363833	294165
	1976	258426	235590	165651	115186	150225	234334	243493	202131	153856	288701	273050	381766	271131	271722
	1957	144996	114342	94200	112296	117592	153070	171661	119047	141780	239870	237642	382814	360015	186755
	average	188485	162834	121262	108482	127379	170280	200364	159059	154922	223670	236498	353125	331660	250881
1997	1974	205885	196584	109058	96918	105363	173788	323427	272167	223246	284614	341697	395329	477777	323071
	1971	202265	183503	102463	101205	116360	113625	216356	265005	172446	225722	271464	428627	382646	250805
	1943	198069	147706	98490	103415	112102	137959	188855	172852	175854	322092	325709	315999	290079	243887
	average	202073	175931	103337	100513	111275	141791	242879	236675	190515	277476	312957	379985	383501	272588
1998	1951	200000	167919	103706	116721	155247	198350	251595	252541	180431	241035	295428	366400	252247	234650
	1949	141523	114440	85874	111155	117654	128949	146211	138602	195968	179636	281083	349796	266101	151540
	1953	193852	148686	101338	99731	117472	116691	144047	181138	113498	130713	183902	268113	342128	231865
	average	178458	143682	96973	109202	130124	147997	180618	190760	163299	183795	253471	328103	286825	206018
1999	1950	200000	163610	106403	102664	114206	116682	164910	200455	225862	221590	261659	292940	411963	271609
	1964	200000	174858	113818	97508	112850	127404	164821	120648	102285	161808	197487	242329	405281	276578
	1969	169643	110918	93112	125067	141703	153993	236148	188094	149100	294351	304629	395953	279849	205728
	average	189881	149795	104444	108413	122920	132693	188626	169732	159082	225916	254592	310407	365698	251305
2000	1942	197522	150202	98914	107443	115304	169822	203988	120011	93733	141589	191545	204390	263935	207948
	1961	149809	129784	88762	100098	122531	127609	172096	180172	162992	198213	231076	264584	398026	182870
	1940	134655	113128	91052	104705	117690	117048	144640	117591	157396	170748	202549	209584	192442	148528
	average	160662	131038	92909	104082	118508	138160	173575	139258	138040	170183	208390	226186	284801	179782

2001	1973	136059	105047	81062	106641	114452	153775	193525	103438	105600	101513	118581	163935	176075	146841
	1931	131424	116075	91238	102614	117676	120396	99150	92694	100085	141503	110756	137120	153278	138697
	1977	133208	109494	89725	107785	116754	125368	144976	94021	88671	101531	102722	144005	144291	113922
	average	133564	110205	87342	105680	116294	133180	145884	96718	98119	114849	110686	148353	157881	133153
2002	1955	202215	182284	101855	115872	139050	146877	128771	100338	96101	123850	143489	201761	381891	300243
	1960	184336	115888	93227	171755	171226	186956	187504	128332	140821	295302	271182	245831	269989	211699
	1963	195412	144256	99416	113240	134556	169938	176598	148143	133130	135729	158136	252477	239948	202937
	average	193988	147476	98166	133622	148277	167924	164291	125604	123351	184960	190936	233356	297276	238293
2003	1961	149809	129784	88762	100098	122531	127609	172096	180172	162992	198213	231076	264584	398026	182870
	1940	134655	113128	91052	104705	117690	117048	144640	117591	157396	170748	202549	209584	192442	148528
	1968	200000	158129	125565	107723	125392	141425	186164	178739	157092	110593	160055	209112	278458	241186
	average	161488	133680	101793	104175	121871	128694	167633	158834	159160	159851	197893	227760	289642	190861

Spring and summer period averages.

	Spring	Spring	Summer	Summer
SIMPAS Study year	Rounded April 10-June 30	April 10-June 30	July 1 – Sept 30	Rounded July 1 – Sept 30
1994	177100	177104	123431	123430
1995	285050	285046	185619	185620
1996	314470	314466	183128	183130
1997	361510	361509	189090	189090
1998	288790	288790	155125	155130
1999	314240	314243	175747	175750
2000	240280	240277	139859	139860
2001	142500	142497	114291	114290
2002	245440	245441	169581	169580
2003	239970	239967	147084	147080

Table A-10. Bonneville Dam monthly and period average discharge for surrogate years under the proposed action. Data from BPA HYDROSIM Model run: FRIII_USNBIOP04.XLS dated 02-19-05.

Bonneville BiOp base case (Proposed Action) Data from: FRIII_USNBIOP04.XLS

1/30/2005

		Total Discharge, in cfs						
SIMPAS Study year	HYDSIM Surrogate years	OCT	NOV	DEC	JAN	FEB	MAR	APR1
1994	1934	127909	172019	282863	343925	265107	203661	296150
	1973	112238	125000	169426	207276	113377	117196	110629
	1931	107757	125000	125653	105100	99839	111767	159456
	average	115968	140673	192647	218767	159441	144208	188745
1995	1946	108095	125000	134129	176468	160395	199392	236124
	1933	108093	125783	159372	209551	189202	122333	163929
	1959	105628	147308	184681	267031	217427	165751	209310
	average	107272	132697	159394	217683	189008	162492	203121
1996	1975	103889	125000	136124	209871	173116	188649	156110
	1976	121151	164364	257584	268755	218935	172651	303799
	1957	118037	126706	168877	182314	130708	171144	264807
	average	114359	138690	187528	220313	174253	177481	241572
1997	1974	102929	125000	205401	358175	290970	242897	302243
	1971	104867	125000	126308	249770	283471	186403	242407
	1943	108536	125000	155655	206469	193367	196244	349882
	average	105444	125000	162455	271471	255936	208515	298177
1998	1951	124791	172558	221963	276669	285438	201651	266210
	1949	116531	128234	141259	153529	156768	220426	195948
	1953	104621	125000	125000	174854	206124	129706	147370
	average	115314	141931	162741	201684	216110	183928	203176
1999	1950	108405	125000	129831	176428	220556	253590	241387
	1964	100292	125000	138075	183602	134940	114561	172852
	1969	129460	155290	166368	253668	201186	164555	314706
	average	112719	135097	144758	204566	185561	177569	242982
2000	1942	113221	125000	193838	216615	137400	105881	155829
	1961	106661	139400	141023	189538	218290	190056	212284
	1940	109771	125000	127767	152747	136277	180792	188313
	average	109884	129800	154209	186300	163989	158910	185475

2001	1973	112238	125000	169426	207276	113377	117196	110629
	1931	107757	125000	125653	105100	99839	111767	159456
	1977	114025	125000	135142	154214	100279	96327	110659
	average	111340	125000	143407	155530	104498	108430	126915
2002	1955	122355	149076	157507	139408	111234	105284	136325
	1960	180606	180487	200020	195724	148967	158708	317167
	1963	118057	148140	187087	188237	172565	146369	149951
	average	140339	159234	181538	174456	144255	136787	201148
2003	1961	106661	139400	141023	189538	218290	190056	212284
	1940	109771	125000	127767	152747	136277	180792	188313
	1968	114256	133868	153002	199446	205231	167865	117613
	average	110229	132756	140597	180577	186599	179571	172737

Chum salmon spawning, incubation, and rearing period average flows (November 1 through April 15)

Year	Season Average Flow
1994	173133
1995	174980
1996	186642
1997	212678
1998	182865
1999	176066
2000	162131
2001	127759
2002	129409
2003	138332

Table A-11. SIMPAS analysis results for spring chinook juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the near term. Source: NMFS staff.

Gap Analysis - Spring Chinook Summary Page											Flow Years
Proposed Near-term Operation	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Sp Chinook System Survival with Wild D	52.4%	47.7%	52.8%	50.0%	52.3%	53.4%	51.3%	53.2%	55.1%	53.2%	52.2%
SR Sp Chin Inriver Survival (without Transport)	50.9%	48.4%	55.4%	50.7%	54.4%	58.3%	48.6%	44.1%	59.0%	55.0%	52.5%
Total % Transported	95.1%	60.9%	73.8%	68.8%	70.5%	72.2%	91.5%	96.7%	64.4%	94.5%	78.8%
UCR Sp Chinook Inriver Survival (4 projects)	71.2%	66.4%	73.8%	71.4%	68.1%	69.8%	65.0%	52.7%	67.4%	67.8%	67.4%
LCR Sp Chinook Inriver Survival (1 project)	92.6%	89.0%	92.8%	91.6%	90.8%	92.4%	86.7%	84.7%	91.1%	89.3%	90.1%
Reference Operation											
SR Sp Chinook System Survival with Wild D	52.4%	48.0%	52.9%	49.8%	52.4%	53.5%	51.0%	53.2%	55.2%	53.3%	52.2%
SR Sp Chin Inriver Survival (without Transport)	51.8%	48.8%	55.7%	50.8%	54.7%	58.6%	51.9%	43.9%	59.5%	55.3%	53.1%
Total % Transported	95.1%	64.0%	76.1%	63.5%	73.0%	73.7%	62.0%	96.7%	67.0%	94.8%	76.6%
UCR Sp Chinook Inriver Survival (4 projects)	71.8%	66.7%	74.0%	71.7%	68.4%	69.8%	65.3%	52.5%	67.8%	66.9%	67.5%
LCR Sp Chinook Inriver Survival (1 project)	92.8%	89.1%	92.9%	91.7%	90.9%	92.4%	86.8%	84.9%	91.2%	89.4%	90.2%
Absolute Difference (Reference-Proposed)											
SR Sp Chinook System Survival with Wild D	0.0%	0.3%	0.1%	-0.3%	0.1%	0.1%	-0.2%	0.0%	0.1%	0.1%	0.0%
SR Sp Chin Inriver Survival (without Transport)	0.8%	0.4%	0.3%	0.2%	0.4%	0.3%	3.4%	-0.1%	0.4%	0.4%	0.6%
Total % Transported	0.0%	3.1%	2.3%	-5.3%	2.6%	1.5%	-29.5%	0.0%	2.6%	0.3%	-2.3%
UCR Sp Chinook Inriver Survival (4 projects)	0.7%	0.3%	0.2%	0.2%	0.3%	0.1%	0.3%	-0.1%	0.3%	-0.9%	0.1%
LCR Sp Chinook Inriver Survival (1 project)	0.2%	0.1%	0.0%	0.2%	0.1%	0.0%	0.1%	0.2%	0.1%	0.1%	0.1%
Relative Difference (Reference/Proposed)											
SR Sp Chinook System Survival with Wild D	100.1%	100.6%	100.2%	99.5%	100.2%	100.2%	99.6%	100.0%	100.1%	100.2%	100.1%
SR Sp Chin Inriver Survival (without Transport)	101.7%	100.8%	100.6%	100.3%	100.7%	100.5%	106.9%	99.7%	100.7%	100.7%	101.2%
UCR Sp Chinook Inriver Survival (4 projects)	100.9%	100.4%	100.3%	100.3%	100.4%	100.1%	100.5%	99.7%	100.5%	98.7%	100.2%
LCR Sp Chinook Inriver Survival (1 project)	100.2%	100.1%	100.0%	100.2%	100.1%	100.0%	100.1%	100.2%	100.1%	100.1%	100.1%

Gap Analysis - Spring Chinook Summary Page											Flow Years
Proposed Near-term Operation	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean Difference in means
Relative Difference ((Proposed-Reference)/Reference)											
SR Sp Chinook System Survival with Wild D	-0.1%	-0.5%	-0.2%	0.5%	-0.2%	-0.2%	0.4%	0.0%	-0.1%	-0.2%	-0.1%
SR Sp Chin Inriver Survival (without Transport)	-1.6%	-0.8%	-0.6%	-0.3%	-0.7%	-0.4%	-6.5%	0.3%	-0.7%	-0.7%	-1.2%
UCR Sp Chinook Inriver Survival (4 projects)	-0.9%	-0.4%	-0.3%	-0.3%	-0.4%	-0.1%	-0.5%	0.3%	-0.5%	1.3%	-0.2%
LCR Sp Chinook Inriver Survival (1 project)	-0.2%	-0.1%	0.0%	-0.2%	-0.1%	0.0%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%

Figure A-1. Snake River spring/summer chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the near term. Source: NMFS staff.

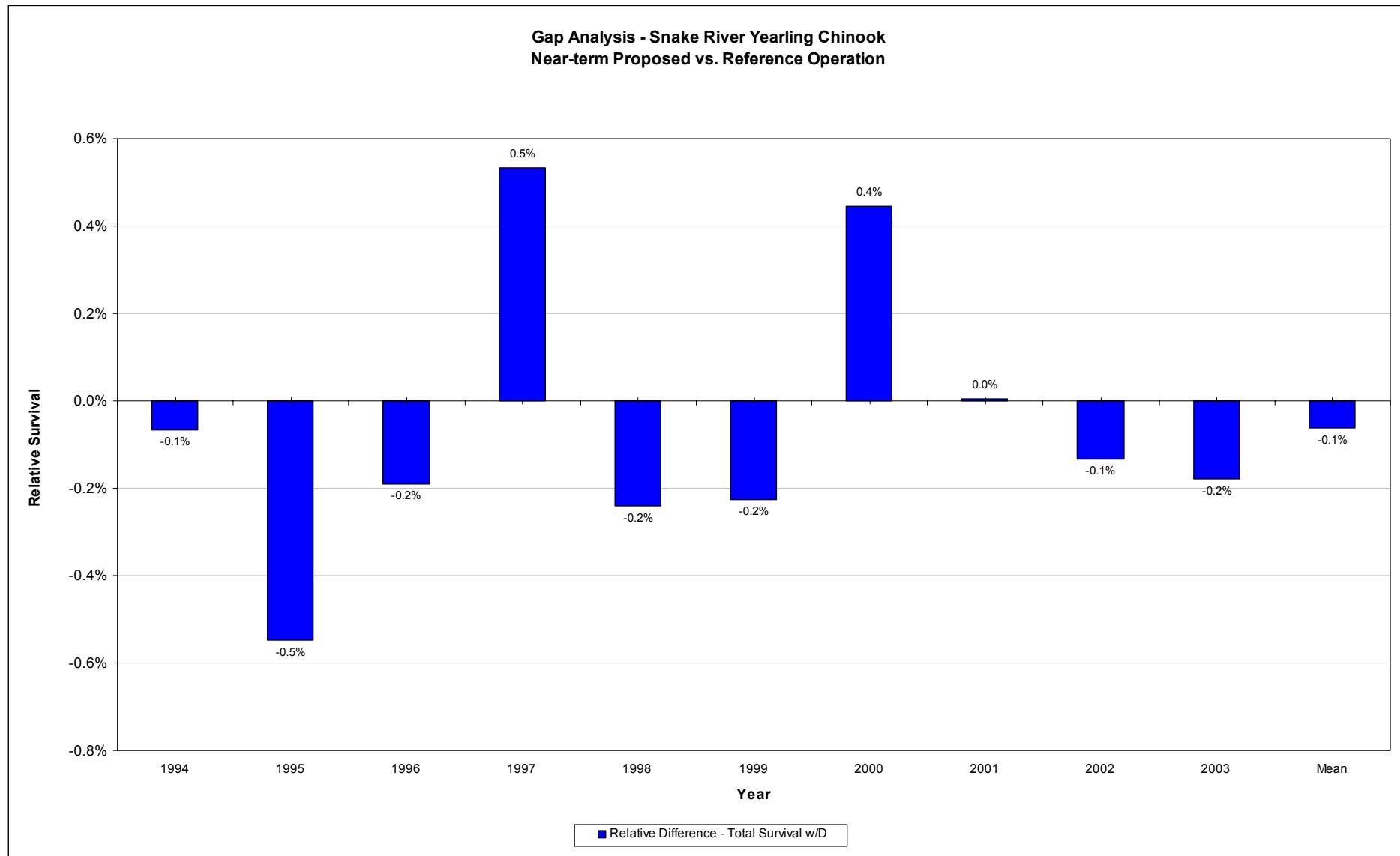


Figure A-2. Upper Columbia River spring chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the near term. Source: NMFS staff.

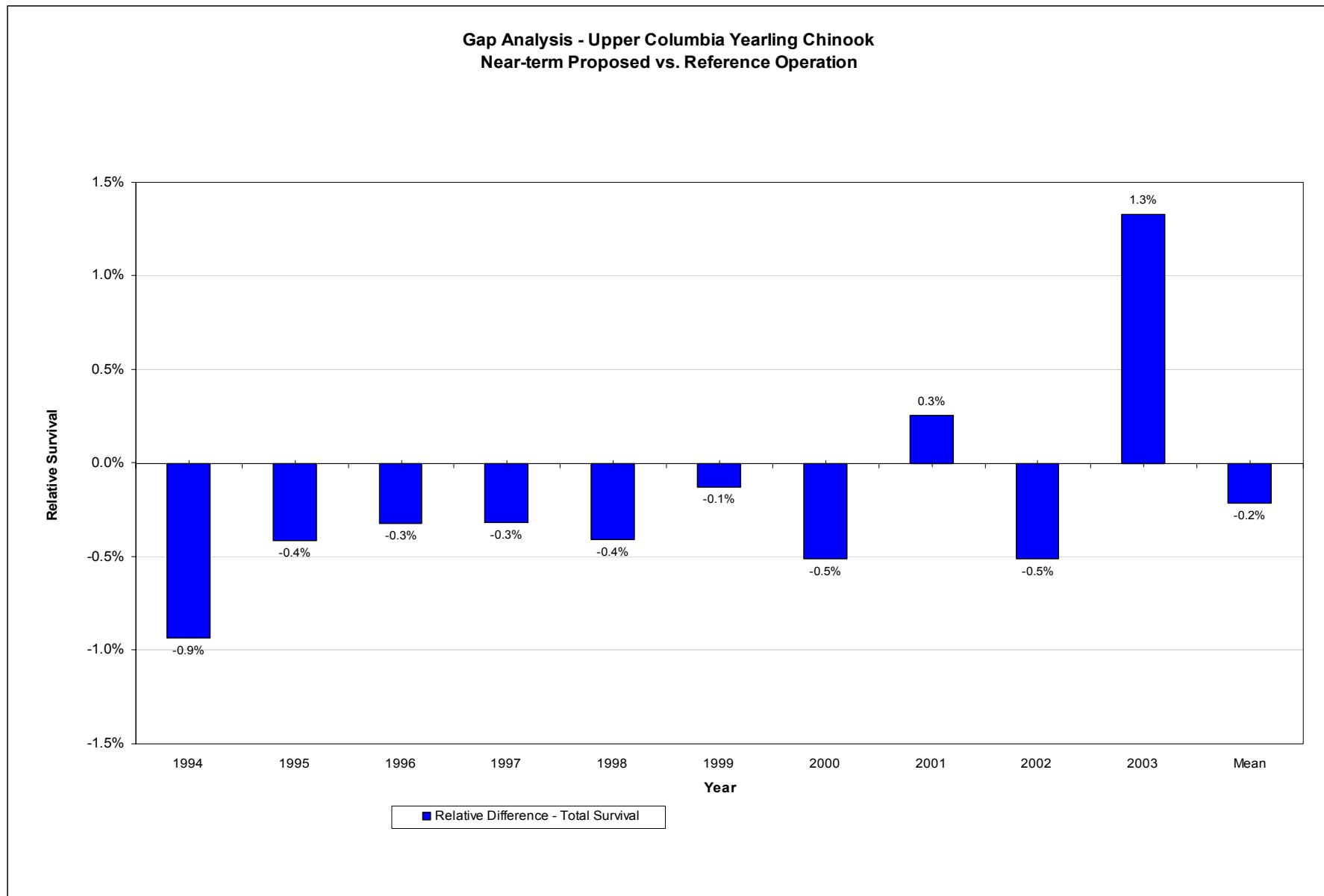


Table A-12. SIMPAS analysis results for spring chinook juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the long term. Source: NMFS staff.

Gap Analysis - Spring Chinook Summary Page											
Proposed Long-term Operation	Flow Years										
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Sp Chinook System Survival with Wild D	52.6%	49.6%	54.2%	51.8%	54.0%	55.3%	51.5%	53.4%	57.6%	53.4%	53.3%
SR Sp Chin Inriver Survival (without Transport)	56.0%	53.3%	61.3%	56.5%	59.9%	64.6%	53.3%	48.7%	64.7%	60.2%	57.8%
Total % Transported	95.2%	58.2%	73.8%	65.2%	68.1%	70.2%	93.3%	96.9%	60.2%	96.5%	77.8%
UCR Sp Chinook Inriver Survival (4 projects)	77.4%	72.0%	80.2%	78.0%	73.8%	75.9%	70.0%	57.5%	72.7%	73.1%	73.1%
LCR Sp Chinook Inriver Survival (1 project)	92.7%	89.7%	94.0%	92.9%	91.6%	93.5%	87.1%	84.8%	91.5%	89.7%	90.8%
Reference Operation											Mean
SR Sp Chinook System Survival with Wild D	52.6%	49.5%	54.1%	53.3%	53.8%	55.0%	52.8%	53.4%	57.3%	53.4%	53.5%
SR Sp Chin Inriver Survival (without Transport)	56.6%	53.5%	61.6%	57.6%	60.2%	64.7%	56.6%	49.1%	64.9%	60.5%	58.5%
Total % Transported	95.3%	61.7%	76.1%	51.8%	71.1%	73.2%	58.0%	96.9%	63.3%	96.5%	74.4%
UCR Sp Chinook Inriver Survival (4 projects)	77.6%	72.4%	80.6%	78.2%	74.2%	76.1%	70.4%	58.0%	73.1%	73.4%	73.4%
LCR Sp Chinook Inriver Survival (1 project)	92.9%	89.9%	94.1%	93.1%	91.8%	93.6%	87.3%	85.0%	91.7%	89.8%	90.9%
Absolute Difference (Reference-Proposed)											Difference in means
SR Sp Chinook System Survival with Wild D	0.0%	-0.1%	-0.1%	1.4%	-0.2%	-0.3%	1.3%	0.0%	-0.3%	0.0%	0.2%
SR Sp Chin Inriver Survival (without Transport)	0.6%	0.2%	0.2%	1.1%	0.3%	0.1%	3.4%	0.4%	0.2%	0.3%	0.7%
Total % Transported	0.0%	3.5%	2.3%	-13.4%	3.0%	3.0%	-35.3%	0.0%	3.0%	0.0%	-3.4%
UCR Sp Chinook Inriver Survival (4 projects)	0.3%	0.4%	0.4%	0.2%	0.4%	0.2%	0.4%	0.5%	0.4%	0.2%	0.3%
LCR Sp Chinook Inriver Survival (1 project)	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.2%
Relative Difference (Reference/Proposed)											Geomean
SR Sp Chinook System Survival with Wild D	100.1%	99.9%	99.8%	102.7%	99.7%	99.4%	102.6%	100.0%	99.5%	100.0%	100.4%
SR Sp Chin Inriver Survival (without Transport)	101.1%	100.4%	100.4%	101.9%	100.5%	100.2%	106.3%	100.9%	100.3%	100.4%	101.2%
UCR Sp Chinook Inriver Survival (4 projects)	100.3%	100.5%	100.5%	100.2%	100.5%	100.3%	100.5%	100.9%	100.6%	100.3%	100.5%
LCR Sp Chinook Inriver Survival (1 project)	100.2%	100.2%	100.2%	100.2%	100.2%	100.2%	100.2%	100.2%	100.2%	100.1%	100.2%

Gap Analysis - Spring Chinook Summary Page		Flow Years										
Proposed Long-term Operation		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
Relative Difference (Proposed-Reference/Reference)										Difference in means		
SR Sp Chinook System Survival with Wild D	-0.1%	0.1%	0.2%	-2.6%	0.3%	0.6%	-2.5%	0.0%	0.5%	0.0%	-0.3%	-0.3%
SR Sp Chin Inriver Survival (without Transport)	-1.0%	-0.4%	-0.4%	-1.9%	-0.5%	-0.2%	-5.9%	-0.8%	-0.3%	-0.4%	-1.1%	-1.1%
UCR Sp Chinook Inriver Survival (4 projects)	-0.3%	-0.5%	-0.5%	-0.2%	-0.5%	-0.3%	-0.5%	-0.9%	-0.6%	-0.3%	-0.5%	-0.5%
LCR Sp Chinook Inriver Survival (1 project)	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%	-0.2%	-0.2%

Figure A-3. Snake River spring/summer chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the long term. Source: NMFS staff.

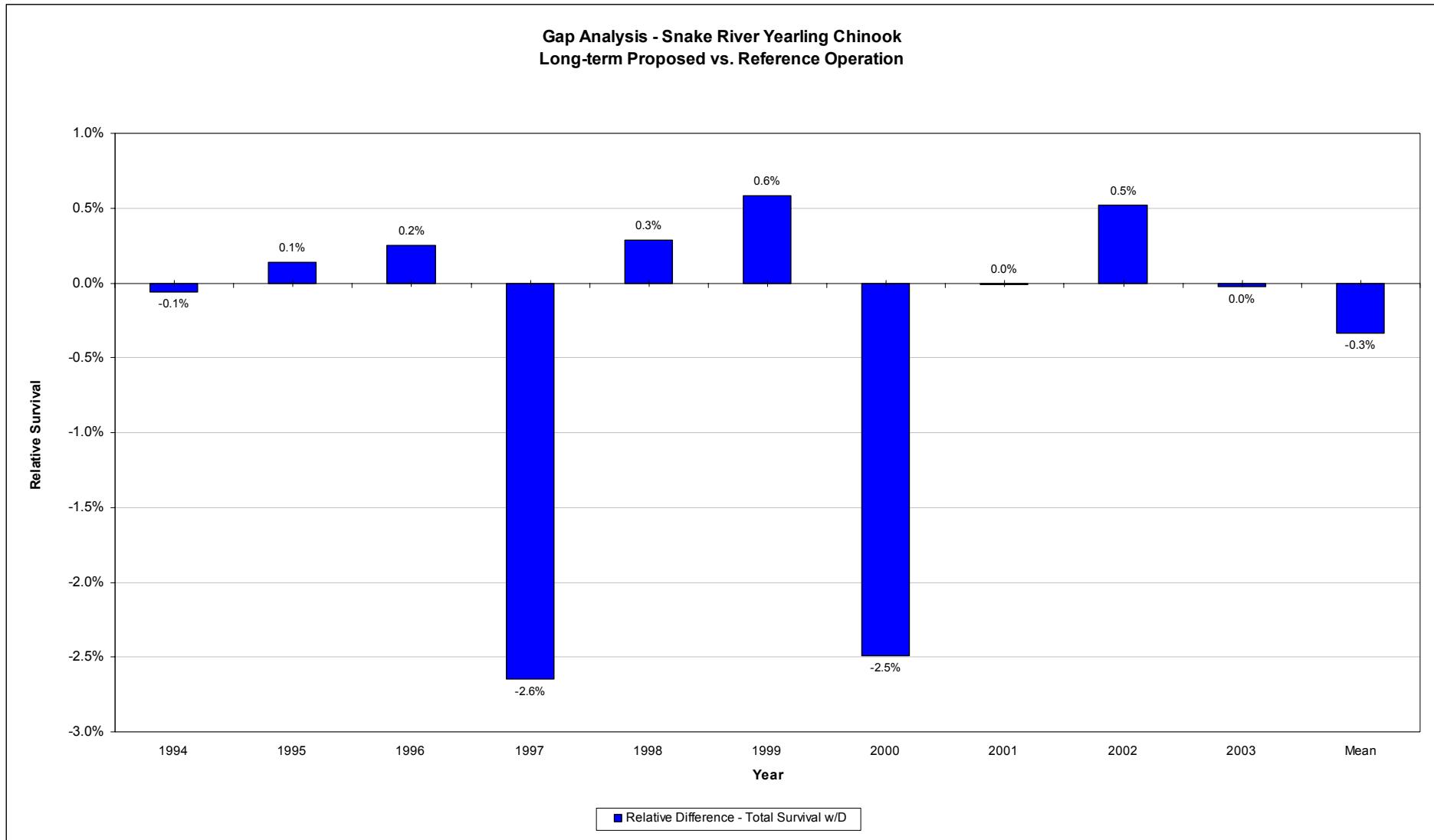


Figure A-4. Upper Columbia River spring chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the long term. Source: NMFS staff.

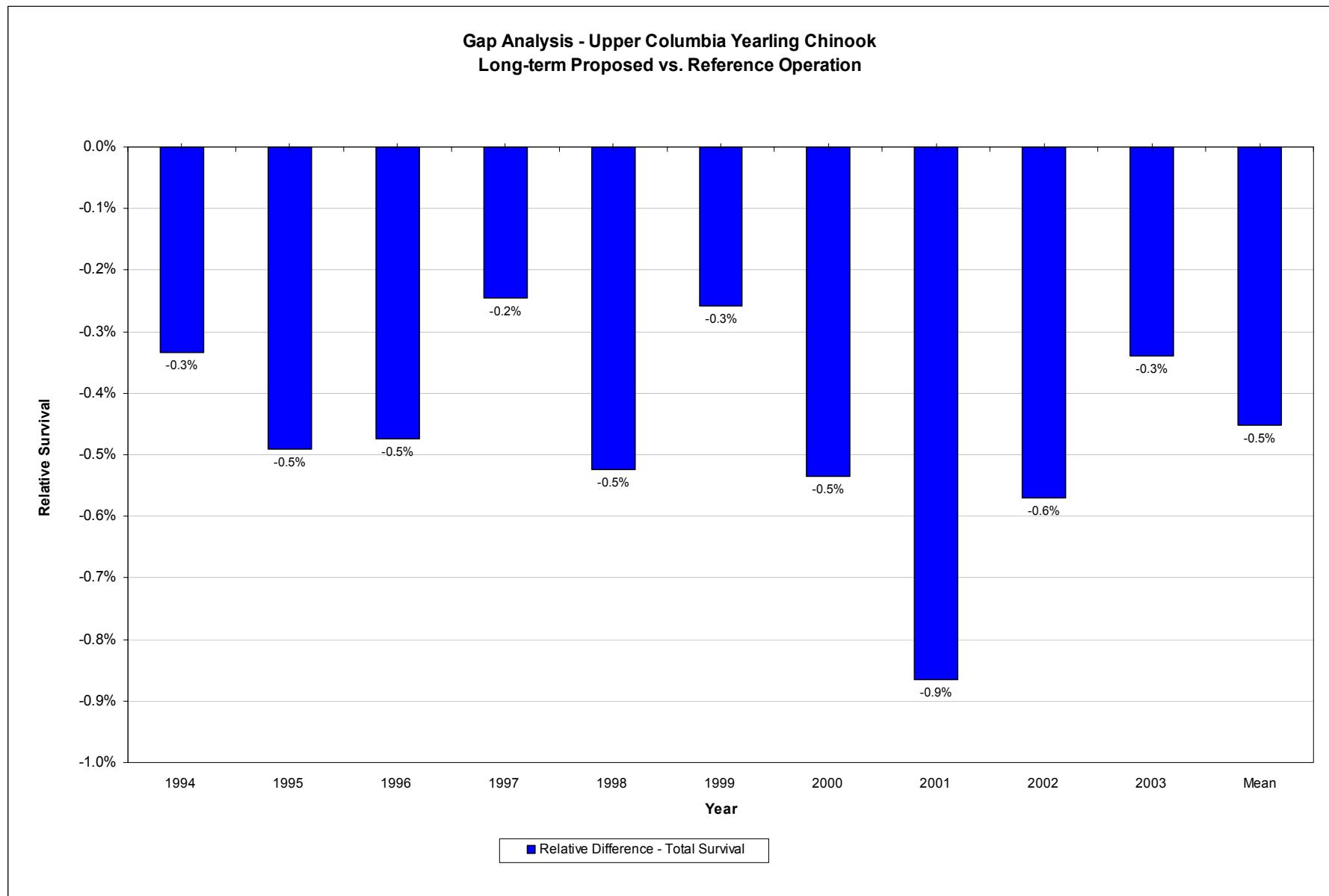


Table A-13. SIMPAS analysis results for steelhead juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the near term. Source: NMFS staff.

Gap Analysis - Steelhead Summary Page		Flow Years										
Proposed Near-term Operation		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Stlhd System Survival with Wild D		41.9%	48.1%	50.9%	51.3%	51.1%	49.7%	53.2%	53.3%	47.1%	51.5%	49.8%
SR Stlhd Inriver Survival (without Transport)		9.1%	39.2%	43.6%	42.1%	45.9%	43.9%	34.0%	7.4%	37.6%	32.6%	33.5%
Total % Transported		73.3%	65.1%	74.5%	75.8%	71.0%	70.6%	92.1%	93.3%	61.2%	89.0%	76.6%
UCR Stlhd Inriver Survival (4 projects)		22.1%	54.5%	60.8%	58.8%	64.3%	61.4%	53.9%	22.1%	54.9%	54.1%	50.7%
MCR Stlhd Inriver Survival (JDA to BON)		30.3%	61.4%	68.9%	65.7%	74.3%	67.3%	61.2%	36.2%	65.9%	61.0%	59.2%
MCR Stlhd Inriver Survival (JDA Dam to BON)		43.5%	73.1%	78.8%	76.3%	88.6%	70.1%	72.1%	89.8%	70.5%	65.8%	72.9%
MCR Stlhd Inriver Survival (TDA to BON)		45.2%	76.1%	82.2%	79.7%	92.3%	73.1%	74.9%	93.3%	73.3%	68.4%	75.8%
LCR Stlhd Inriver Survival (BON)		64.2%	87.6%	90.9%	89.3%	96.3%	84.3%	86.0%	97.4%	84.0%	81.2%	86.1%
Reference Operation												Mean
SR Stlhd System Survival with Wild D		42.9%	49.5%	51.2%	50.7%	51.7%	50.2%	47.9%	54.8%	48.4%	52.2%	50.0%
SR Stlhd Inriver Survival (without Transport)		10.2%	39.9%	44.0%	42.3%	46.1%	44.2%	38.1%	8.2%	39.3%	34.7%	34.7%
Total % Transported		75.1%	73.6%	76.4%	72.2%	77.9%	75.5%	63.0%	95.9%	64.6%	90.2%	76.5%
UCR Stlhd Inriver Survival (4 projects)		22.7%	55.1%	61.2%	59.0%	64.6%	61.7%	55.0%	22.3%	55.9%	54.6%	51.2%
MCR Stlhd Inriver Survival (JDA to BON)		31.0%	61.9%	69.2%	65.9%	74.4%	67.6%	62.1%	36.5%	66.8%	61.6%	59.7%
MCR Stlhd Inriver Survival (JDA Dam to BON)		44.2%	73.5%	79.0%	76.4%	88.5%	70.2%	72.8%	89.8%	71.2%	66.3%	73.2%
MCR Stlhd Inriver Survival (2 projects)		45.9%	76.5%	82.4%	79.8%	92.1%	73.3%	75.6%	93.3%	73.9%	68.8%	76.2%
LCR Stlhd Inriver Survival (1 project)		64.7%	87.8%	90.9%	89.4%	96.2%	84.4%	86.3%	97.4%	84.4%	81.4%	86.3%
Absolute Difference (Reference-Proposed)												Mean
SR Stlhd System Survival with Wild D		1.0%	1.4%	0.4%	-0.6%	0.7%	0.5%	-5.3%	1.5%	1.3%	0.7%	0.2%
SR Stlhd Inriver Survival (without Transport)		1.1%	0.7%	0.4%	0.2%	0.2%	0.3%	4.1%	0.9%	1.7%	2.1%	1.2%
Total % Transported		1.8%	8.5%	1.9%	-3.6%	6.9%	4.8%	-29.0%	2.6%	3.4%	1.2%	-0.2%
UCR Stlhd Inriver Survival (4 projects)		0.6%	0.6%	0.4%	0.2%	0.3%	0.4%	1.1%	0.3%	1.0%	0.5%	0.5%
MCR Stlhd Inriver Survival (JDA to BON)		0.7%	0.5%	0.3%	0.2%	0.1%	0.3%	0.9%	0.3%	0.9%	0.6%	0.5%
MCR Stlhd Inriver Survival (JDA Dam to BON)		0.7%	0.3%	0.1%	0.1%	-0.2%	0.1%	0.7%	0.0%	0.6%	0.4%	0.3%
MCR Stlhd Inriver Survival (TDA to BON)		0.7%	0.4%	0.2%	0.1%	-0.1%	0.2%	0.7%	0.0%	0.7%	0.5%	0.3%
LCR Stlhd Inriver Survival (BON)		0.5%	0.2%	0.1%	0.1%	-0.1%	0.0%	0.4%	0.0%	0.3%	0.2%	0.2%

Gap Analysis - Steelhead Summary Page											
	Flow Years										
Proposed Near-term Operation	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
Relative Difference (Reference/Proposed)											
SR Stlhd System Survival with Wild D	102.5%	102.9%	100.7%	98.7%	101.3%	101.1%	90.1%	102.8%	102.9%	101.3%	100.4%
SR Stlhd Inriver Survival (without Transport)	111.6%	101.7%	100.9%	100.5%	100.4%	100.6%	112.0%	111.8%	104.5%	106.5%	104.9%
UCR Stlhd Inriver Survival (4 projects)	102.7%	101.1%	100.6%	100.4%	100.4%	100.6%	102.0%	101.3%	101.9%	100.9%	101.2%
MCR Stlhd Inriver Survival (JDA to BON)	102.4%	100.8%	100.4%	100.3%	100.1%	100.4%	101.5%	100.9%	101.4%	101.0%	100.9%
MCR Stlhd Inriver Survival (JDA Dam to BON)	101.6%	100.5%	100.2%	100.2%	99.8%	100.2%	101.0%	100.0%	100.9%	100.7%	100.5%
MCR Stlhd Inriver Survival (TDA to BON)	101.6%	100.5%	100.3%	100.2%	99.9%	100.3%	101.0%	100.0%	100.9%	100.7%	100.5%
LCR Stlhd Inriver Survival (BON)	100.8%	100.2%	100.1%	100.1%	99.9%	100.1%	100.4%	100.0%	100.4%	100.3%	100.2%
Relative Difference (Proposed-Reference/Reference)											
SR Stlhd System Survival with Wild D	-2.4%	-2.8%	-0.7%	1.3%	-1.3%	-1.1%	11.0%	-2.7%	-2.8%	-1.3%	-0.3%
SR Stlhd Inriver Survival (without Transport)	-10.4%	-1.7%	-0.9%	-0.5%	-0.4%	-0.6%	-10.7%	-10.5%	-4.3%	-6.1%	-3.3%
UCR Stlhd Inriver Survival (4 projects)	-2.6%	-1.1%	-0.6%	-0.4%	-0.4%	-0.6%	-2.0%	-1.3%	-1.9%	-0.9%	-1.1%
MCR Stlhd Inriver Survival (JDA to BON)	-2.3%	-0.8%	-0.4%	-0.3%	-0.1%	-0.4%	-1.5%	-0.9%	-1.4%	-1.0%	-0.8%
MCR Stlhd Inriver Survival (JDA Dam to BON)	-1.5%	-0.5%	-0.2%	-0.2%	0.2%	-0.2%	-1.0%	0.0%	-0.9%	-0.7%	-0.4%
MCR Stlhd Inriver Survival (TDA to BON)	-1.5%	-0.5%	-0.3%	-0.2%	0.1%	-0.3%	-1.0%	0.0%	-0.9%	-0.7%	-0.4%
LCR Stlhd Inriver Survival (BON)	-0.8%	-0.2%	-0.1%	-0.1%	0.1%	-0.1%	-0.4%	0.0%	-0.4%	-0.3%	-0.2%

Figure A-5. Snake River steelhead juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the near term. Source: NMFS staff.

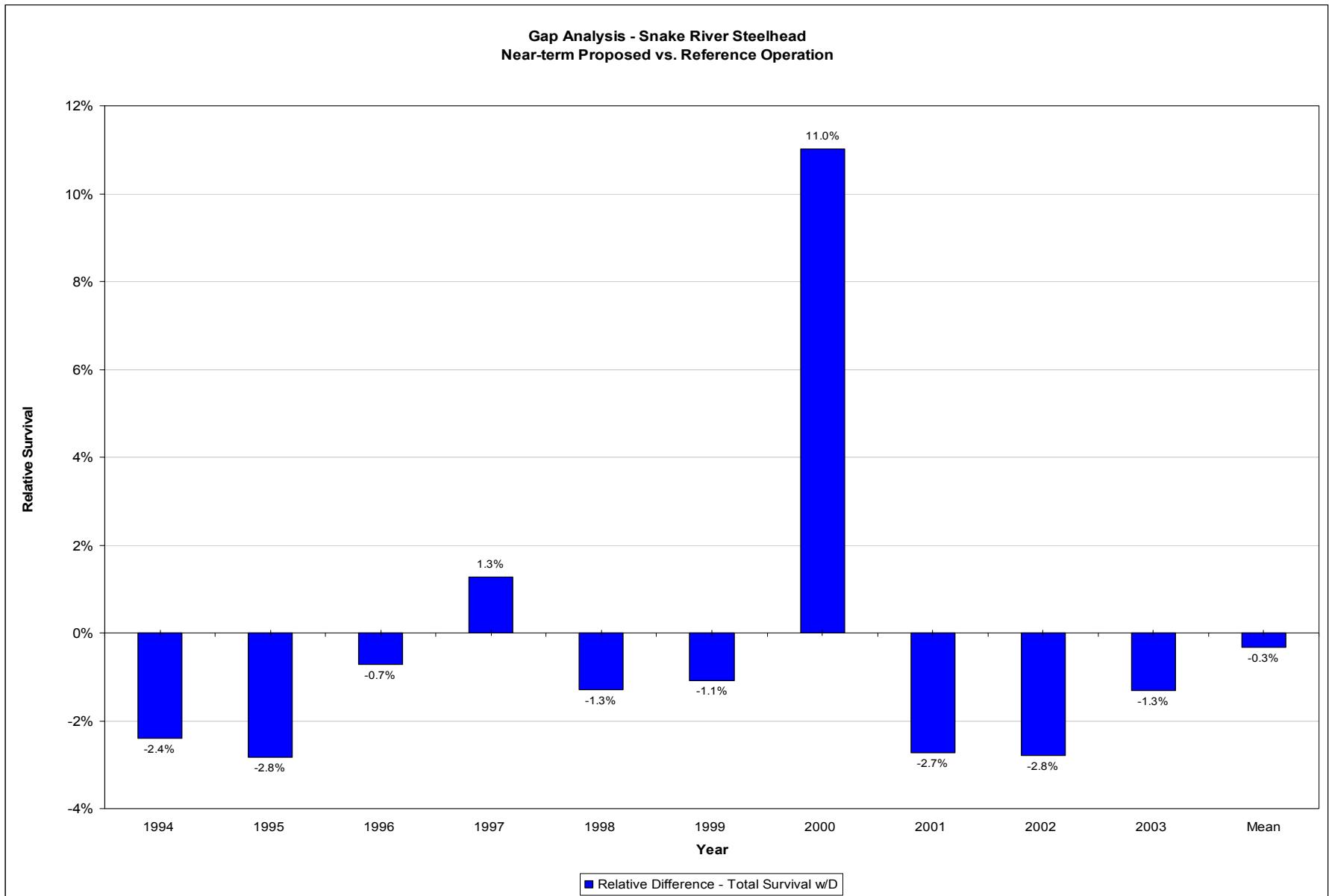


Figure A-6. Upper Columbia River steelhead juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the near term. Source: NMFS staff.

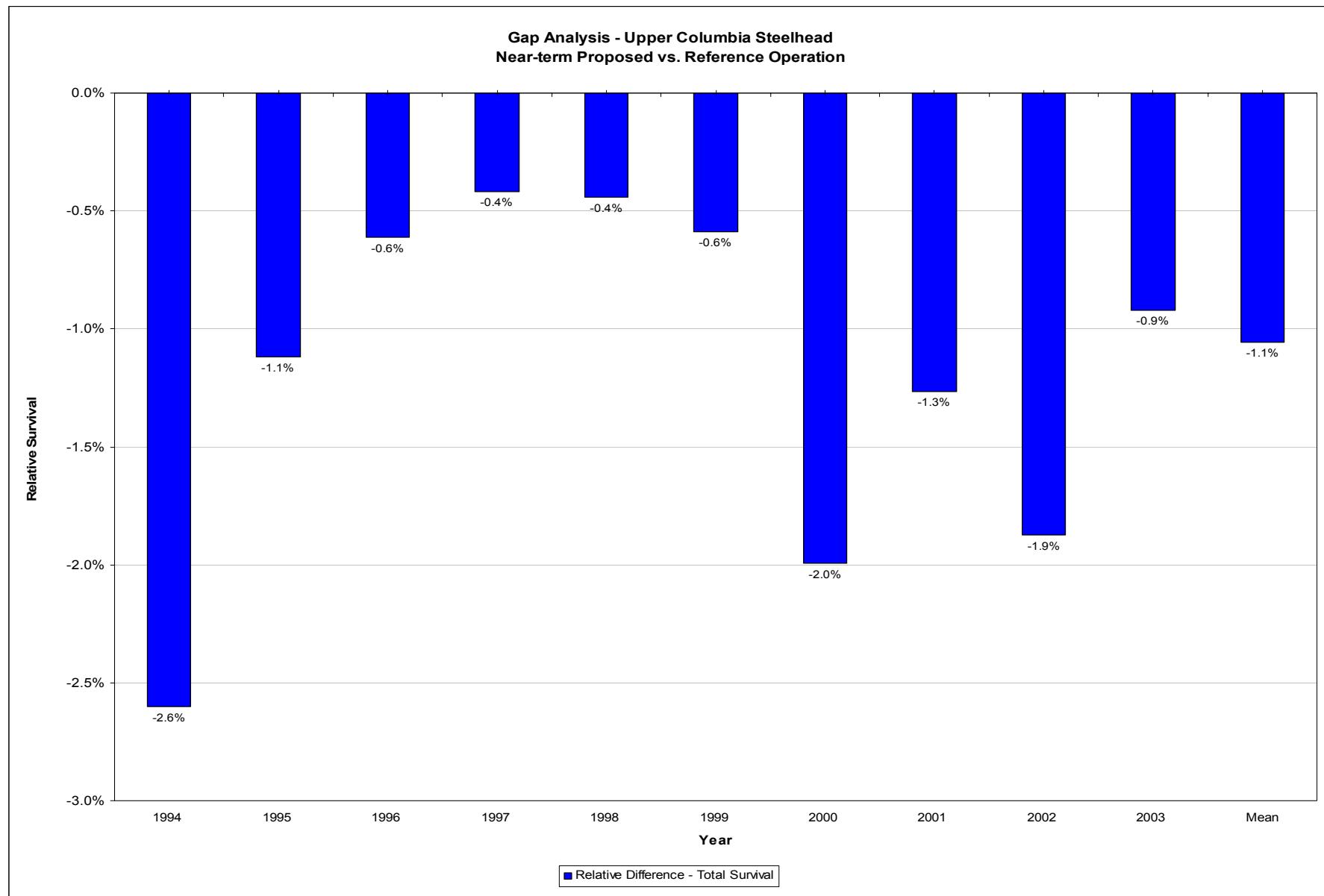


Table A-14. SIMPAS analysis results for steelhead juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the long term. Source: NMFS staff.

Gap Analysis - Steelhead Summary Page		Flow Years										
Proposed Long-term Operation		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Stlhd System Survival with Wild D		42.0%	49.2%	51.8%	52.1%	52.1%	50.7%	53.6%	53.4%	48.2%	51.9%	50.5%
SR Stlhd Inriver Survival (without Transport)		9.9%	43.0%	48.0%	47.1%	50.3%	48.4%	36.2%	8.0%	41.0%	34.5%	36.6%
Total % Transported		73.5%	64.9%	75.9%	72.8%	71.2%	70.9%	93.5%	93.5%	60.6%	90.6%	76.7%
UCR Stlhd Inriver Survival (4 projects)		23.9%	58.9%	65.9%	63.9%	69.4%	66.6%	57.8%	23.9%	58.9%	57.8%	54.7%
MCR Stlhd Inriver Survival (JDA to BON)		31.4%	64.2%	72.5%	69.4%	77.7%	70.8%	63.7%	37.5%	68.5%	63.4%	61.9%
MCR Stlhd Inriver Survival (JDA Dam to BON)		45.1%	76.5%	82.9%	80.5%	92.8%	73.7%	75.0%	93.0%	73.4%	68.4%	76.1%
MCR Stlhd Inriver Survival (TDA to BON)		46.3%	78.6%	85.2%	82.9%	95.3%	75.7%	77.0%	95.5%	75.3%	70.3%	78.2%
LCR Stlhd Inriver Survival (BON)		64.4%	88.6%	92.2%	90.9%	97.4%	85.6%	86.5%	97.6%	84.6%	81.7%	87.0%
Reference Operation												Mean
SR Stlhd System Survival with Wild D		43.0%	49.9%	52.0%	51.6%	52.4%	50.9%	48.5%	54.9%	49.3%	52.4%	50.5%
SR Stlhd Inriver Survival (without Transport)		11.1%	43.9%	48.3%	48.0%	50.8%	48.8%	40.8%	9.0%	42.7%	36.2%	38.0%
Total % Transported		75.3%	68.7%	77.9%	58.9%	74.1%	73.7%	62.0%	96.1%	64.1%	91.6%	74.2%
UCR Stlhd Inriver Survival (4 projects)		24.6%	59.6%	66.4%	64.1%	69.8%	67.0%	59.0%	24.3%	60.0%	58.6%	55.4%
MCR Stlhd Inriver Survival (JDA to BON)		32.2%	64.8%	72.9%	69.6%	78.0%	71.2%	64.7%	37.8%	69.5%	64.1%	62.5%
MCR Stlhd Inriver Survival (JDA Dam to BON)		45.8%	77.0%	83.2%	80.7%	92.7%	73.9%	75.8%	93.0%	74.1%	68.9%	76.5%
MCR Stlhd Inriver Survival (2 projects)		47.0%	79.1%	85.5%	83.0%	95.3%	76.0%	77.8%	95.5%	76.1%	70.8%	78.6%
LCR Stlhd Inriver Survival (1 project)		64.9%	88.8%	92.4%	91.0%	97.4%	85.8%	86.9%	97.6%	85.0%	82.0%	87.2%
Absolute Difference (Reference-Proposed)												Difference in means
SR Stlhd System Survival with Wild D		1.0%	0.8%	0.2%	-0.6%	0.3%	0.2%	-5.1%	1.5%	1.2%	0.6%	0.0%
SR Stlhd Inriver Survival (without Transport)		1.2%	0.8%	0.3%	0.9%	0.4%	0.4%	4.6%	1.0%	1.6%	1.7%	1.3%
Total % Transported		1.8%	3.8%	2.0%	-13.9%	3.0%	2.8%	-31.5%	2.6%	3.5%	0.9%	-2.5%
UCR Stlhd Inriver Survival (4 projects)		0.7%	0.7%	0.5%	0.2%	0.4%	0.5%	1.2%	0.4%	1.2%	0.8%	0.7%
MCR Stlhd Inriver Survival (JDA to BON)		0.7%	0.6%	0.4%	0.2%	0.2%	0.4%	1.0%	0.3%	1.0%	0.7%	0.6%
MCR Stlhd Inriver Survival (JDA Dam to BON)		0.7%	0.5%	0.3%	0.2%	0.0%	0.3%	0.8%	0.0%	0.7%	0.5%	0.4%
MCR Stlhd Inriver Survival (TDA to BON)		0.7%	0.5%	0.4%	0.2%	0.0%	0.3%	0.8%	0.0%	0.7%	0.5%	0.4%

Gap Analysis - Steelhead Summary Page											
Proposed Long-term Operation	Flow Years										Mean
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
LCR Stlhd Inriver Survival (BON)	0.5%	0.3%	0.2%	0.1%	0.0%	0.2%	0.4%	0.0%	0.4%	0.3%	0.2%
Relative Difference (Reference/Proposed)											Geomean
SR Stlhd System Survival with Wild D	102.5%	101.5%	100.3%	98.9%	100.5%	100.5%	90.5%	102.8%	102.5%	101.1%	100.0%
SR Stlhd Inriver Survival (without Transport)	112.1%	101.9%	100.6%	102.0%	100.8%	100.8%	112.7%	112.3%	104.0%	105.0%	105.1%
UCR Stlhd Inriver Survival (4 projects)	103.1%	101.2%	100.8%	100.3%	100.6%	100.7%	102.1%	101.8%	102.0%	101.4%	101.4%
MCR Stlhd Inriver Survival (JDA to BON)	102.4%	100.9%	100.6%	100.3%	100.3%	100.6%	101.6%	100.9%	101.5%	101.1%	101.0%
MCR Stlhd Inriver Survival (JDA Dam to BON)	101.6%	100.6%	100.4%	100.2%	100.0%	100.4%	101.0%	100.0%	101.0%	100.7%	100.6%
MCR Stlhd Inriver Survival (TDA to BON)	101.6%	100.6%	100.4%	100.2%	100.0%	100.4%	101.0%	100.0%	101.0%	100.7%	100.6%
LCR Stlhd Inriver Survival (BON)	100.8%	100.3%	100.2%	100.1%	100.0%	100.2%	100.5%	100.0%	100.5%	100.4%	100.3%
Relative Difference (Proposed-Reference/Reference)											Difference in means
SR Stlhd System Survival with Wild D	-2.4%	-1.5%	-0.3%	1.1%	-0.5%	-0.5%	10.5%	-2.7%	-2.4%	-1.1%	0.0%
SR Stlhd Inriver Survival (without Transport)	-10.8%	-1.9%	-0.6%	-2.0%	-0.8%	-0.8%	-11.2%	-11.0%	-3.8%	-4.8%	-3.4%
UCR Stlhd Inriver Survival (4 projects)	-3.0%	-1.2%	-0.8%	-0.3%	-0.6%	-0.7%	-2.0%	-1.7%	-1.9%	-1.4%	-1.2%
MCR Stlhd Inriver Survival (JDA to BON)	-2.3%	-0.9%	-0.6%	-0.3%	-0.3%	-0.6%	-1.5%	-0.9%	-1.5%	-1.1%	-0.9%
MCR Stlhd Inriver Survival (JDA Dam to BON)	-1.5%	-0.6%	-0.4%	-0.2%	0.0%	-0.4%	-1.0%	0.0%	-1.0%	-0.7%	-0.5%
MCR Stlhd Inriver Survival (TDA to BON)	-1.5%	-0.6%	-0.4%	-0.2%	0.0%	-0.4%	-1.0%	0.0%	-1.0%	-0.7%	-0.5%
LCR Stlhd Inriver Survival (BON)	-0.8%	-0.3%	-0.2%	-0.1%	0.0%	-0.2%	-0.5%	0.0%	-0.5%	-0.4%	-0.3%

Figure A-7. Snake River steelhead juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the long term. Source: NMFS staff.

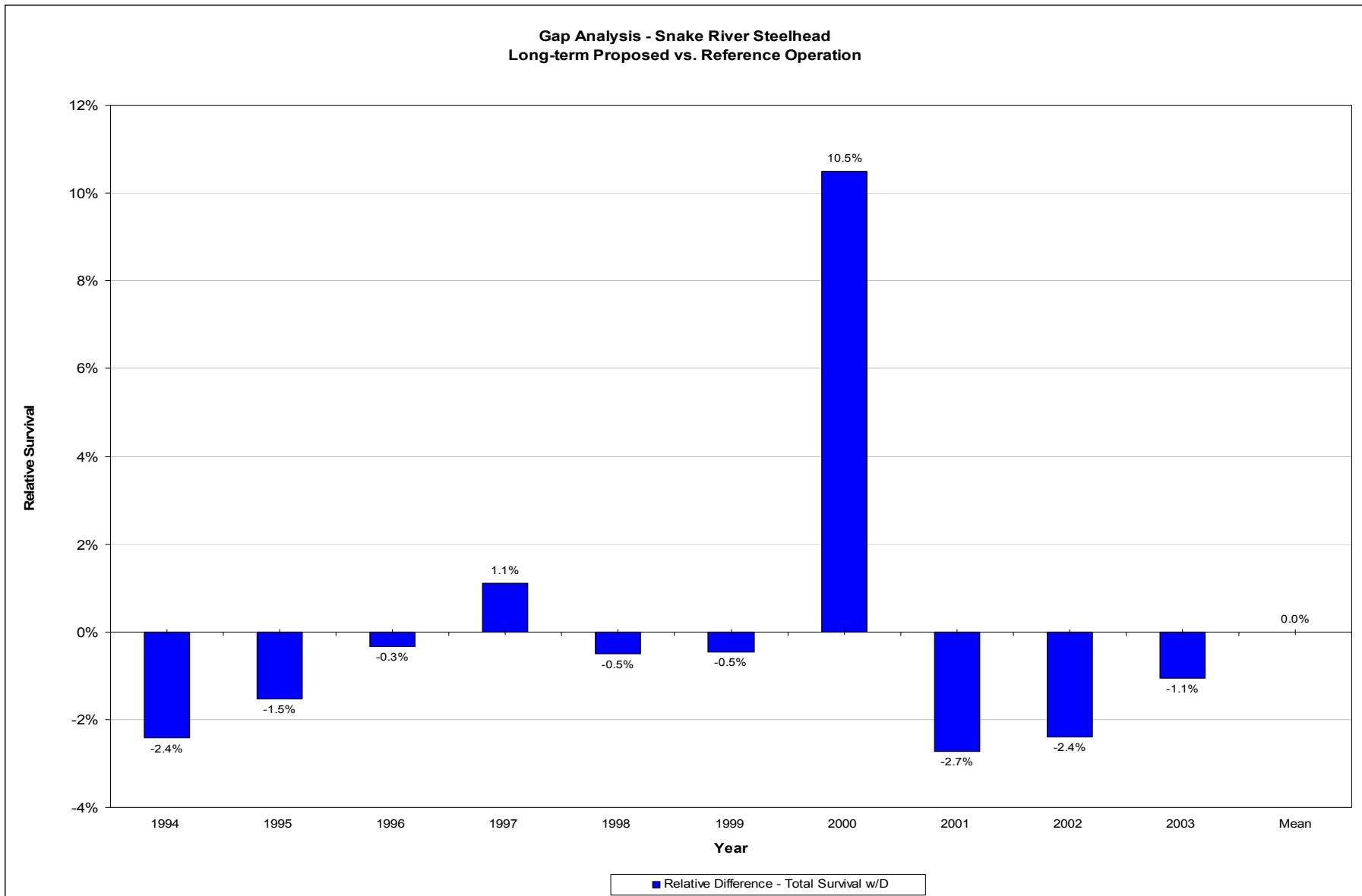


Figure A-8. Upper Columbia River steelhead juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the long term. Source: NMFS staff.

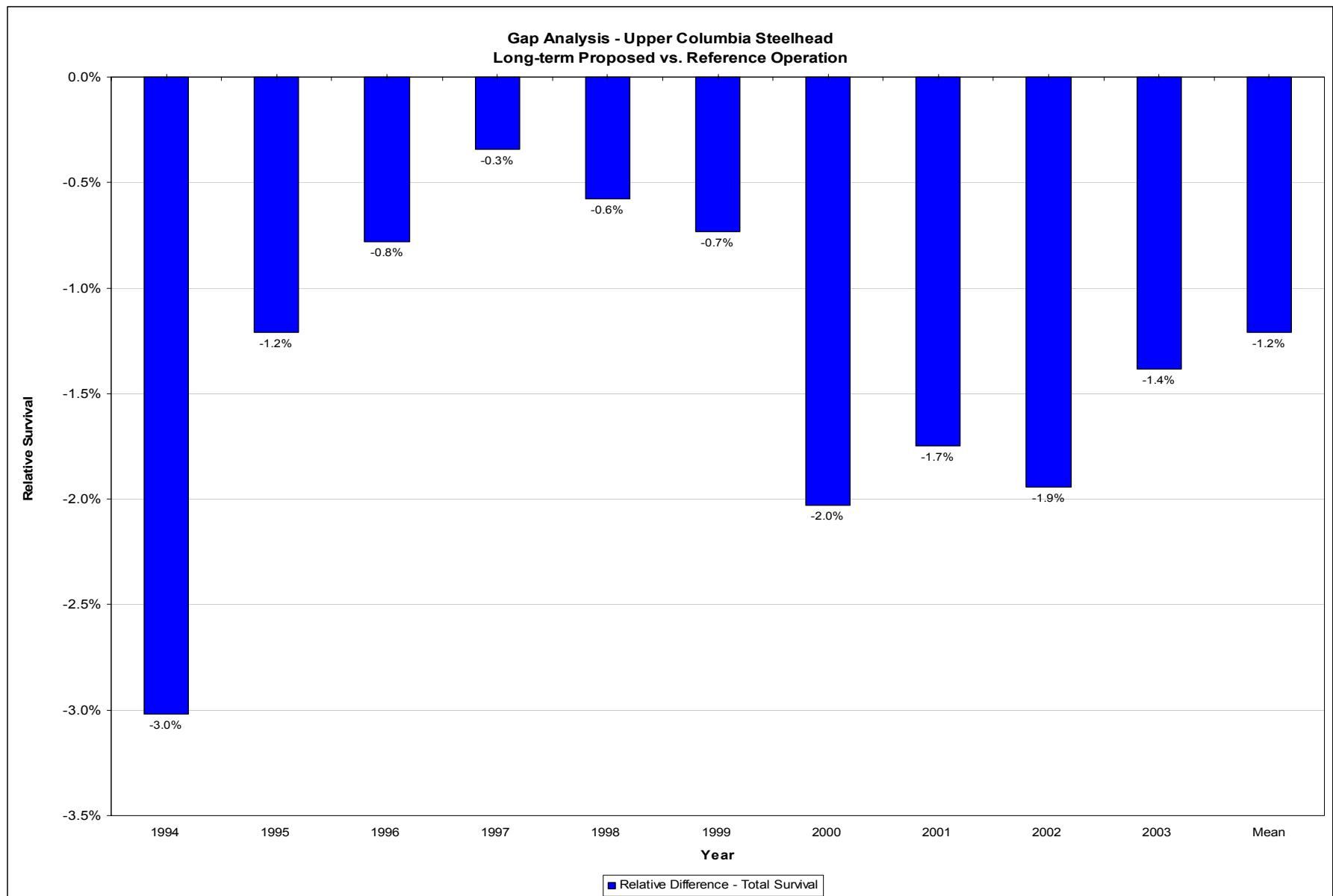


Table A-15. SIMPAS analysis results for fall chinook juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the long term assuming D=0.18. Source: NMFS staff.

Gap Analysis - Fall Chinook Summary Page - D=0.18										Flow Years	
Proposed Near-term Operation	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Fall Chinook System Survival with Mixed D	10.3%	8.7%	8.2%	9.0%	10.8%	8.1%	3.7%			8.6%	8.4%
SR Fall Chinook System Survival w/o D	54.8%	44.9%	40.9%	47.9%	57.2%	42.9%	19.5%			45.7%	44.2%
SR Fall Chinook Inriver Survival (without Transport)	12.3%	18.1%	21.7%	13.8%	15.9%	13.3%	6.1%			12.9%	14.3%
Total % Transported	55.4%	45.0%	40.8%	48.4%	57.8%	43.3%	19.7%			46.2%	44.6%
LCR Fall Chinook Inriver Survival (1 project)	78.3%	87.6%	97.3%	82.0%	85.1%	84.1%	91.6%			82.8%	86.1%
Reference Operation											Mean
SR Fall Chinook System Survival with Mixed D	10.1%	8.6%	8.1%	9.0%	10.8%	7.5%	2.8%			8.0%	8.1%
SR Fall Chinook System Survival w/o D	54.2%	44.9%	41.0%	47.6%	57.2%	39.7%	15.2%			42.5%	42.8%
SR Fall Chinook Inriver Survival (without Transport)	11.9%	17.9%	21.6%	13.5%	15.8%	10.9%	3.0%			10.6%	13.1%
Total % Transported	54.9%	45.1%	40.9%	48.1%	57.8%	40.2%	15.4%			43.0%	43.2%
LCR Fall Chinook Inriver Survival (1 project)	78.2%	87.5%	97.2%	81.8%	85.0%	84.1%	91.3%			82.6%	86.0%
Absolute Difference (Reference-Proposed)											Difference in means
SR Fall Chinook System Survival with Mixed D	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.6%	-0.9%			-0.6%	-0.3%
SR Fall Chinook System Survival w/o D	-0.6%	0.0%	0.0%	-0.3%	0.0%	-3.1%	-4.3%			-3.2%	-1.4%
SR Fall Chinook Inriver Survival (without Transport)	-0.5%	-0.2%	-0.1%	-0.3%	-0.1%	-2.5%	-3.1%			-2.3%	-1.1%
Total % Transported	-0.5%	0.1%	0.1%	-0.3%	0.0%	-3.1%	-4.3%			-3.2%	-1.4%
LCR Fall Chinook Inriver Survival (1 project)	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	0.0%	-0.3%			-0.2%	-0.1%
Relative Difference (Reference/Proposed)											Geomean
SR Fall Chinook System Survival with Mixed D	98.6%	99.6%	99.5%	99.4%	99.7%	92.1%	76.5%			92.6%	96.4%
SR Fall Chinook System Survival w/o D	99.0%	100.0%	100.0%	99.4%	100.0%	92.7%	77.8%			93.0%	96.7%
SR Fall Chinook Inriver Survival (without Transport)	96.3%	99.1%	99.3%	97.6%	99.1%	81.3%	49.8%			82.1%	92.0%
LCR Fall Chinook Inriver Survival (1 project)	99.9%	99.9%	99.9%	99.8%	99.9%	100.0%	99.7%			99.8%	99.8%

Gap Analysis - Fall Chinook Summary Page - D=0.18		Flow Years										
Proposed Near-term Operation		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean Difference in means
Relative Difference ((Proposed-Reference)/Reference)												
SR Fall Chinook System Survival with Mixed D		1.4%	0.4%	0.5%	0.7%	0.3%	8.5%	30.8%			8.0%	3.8%
SR Fall Chinook System Survival w/o D		1.0%	0.0%	0.0%	0.6%	0.0%	7.9%	28.6%			7.5%	3.4%
SR Fall Chinook Inriver Survival (without Transport)		3.9%	0.9%	0.7%	2.4%	0.9%	23.0%	100.8%			21.8%	8.7%
LCR Fall Chinook Inriver Survival (1 project)		0.1%	0.1%	0.1%	0.2%	0.1%	0.0%	0.3%			0.2%	0.2%

Figure A-9. Snake River fall chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the near term assuming D=0.18. Source: NMFS staff.

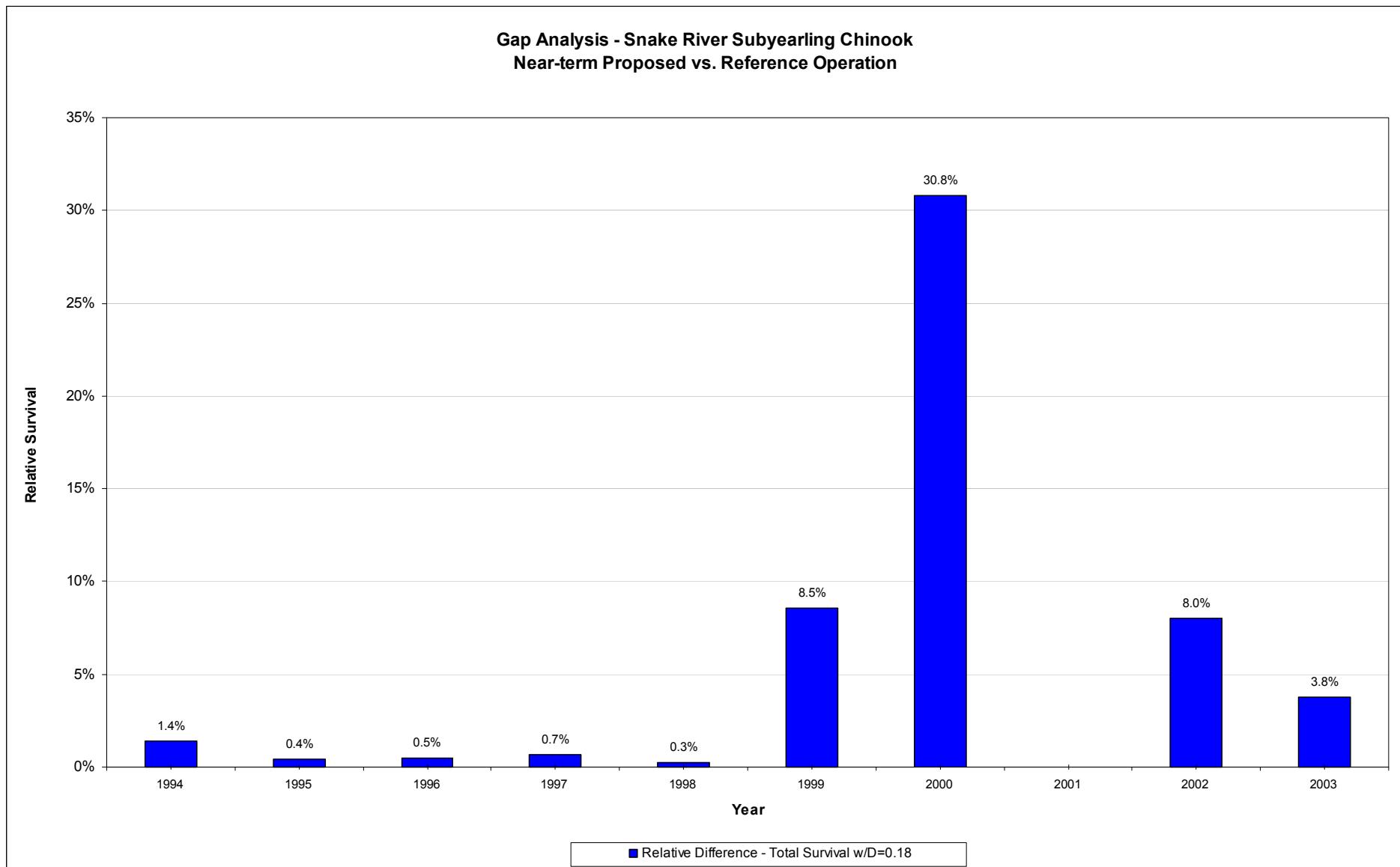


Table A-16. SIMPAS analysis results for fall chinook juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the long term assuming D=0.18. Source: NMFS staff.

Gap Analysis - Fall Chinook Summary Page - D=0.18										Flow Years	
Proposed Long-term Operation	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Fall Chinook System Survival with Mixed D	10.4%	8.8%	8.3%	9.1%	10.9%	8.2%	3.7%	8.7%	8.5%		
SR Fall Chinook System Survival w/o D	55.2%	45.3%	41.3%	48.3%	57.6%	43.2%	19.7%	46.1%	44.6%		
SR Fall Chinook Inriver Survival (without Transport)	14.0%	20.6%	24.7%	15.7%	18.1%	15.2%	6.9%	14.6%	16.2%		
Total % Transported	55.7%	45.3%	41.0%	48.7%	58.1%	43.6%	19.8%	46.5%	44.8%		
LCR Fall Chinook Inriver Survival (1 project)	78.4%	87.7%	97.4%	82.1%	85.2%	84.2%	91.6%	82.9%	86.2%		
Reference Operation											
SR Fall Chinook System Survival with Mixed D	10.3%	8.8%	8.3%	9.1%	10.9%	7.6%	2.8%	8.0%	8.2%		
SR Fall Chinook System Survival w/o D	54.6%	45.3%	41.3%	48.0%	57.6%	40.0%	15.3%	42.8%	43.1%		
SR Fall Chinook Inriver Survival (without Transport)	13.5%	20.4%	24.5%	15.3%	18.0%	12.3%	3.4%	12.0%	14.9%		
Total % Transported	55.2%	45.4%	41.1%	48.4%	58.1%	40.4%	15.5%	43.3%	43.4%		
LCR Fall Chinook Inriver Survival (1 project)	78.3%	87.6%	97.3%	81.9%	85.1%	84.2%	91.3%	82.7%	86.1%		
Absolute Difference (Reference-Proposed)											
Difference in means											
SR Fall Chinook System Survival with Mixed D	-0.2%	0.0%	0.0%	-0.1%	0.0%	-0.7%	-0.9%	-0.7%	-0.3%		
SR Fall Chinook System Survival w/o D	-0.6%	0.0%	0.0%	-0.3%	0.0%	-3.2%	-4.4%	-3.2%	-1.5%		
SR Fall Chinook Inriver Survival (without Transport)	-0.5%	-0.2%	-0.1%	-0.4%	-0.2%	-2.8%	-3.5%	-2.6%	-1.3%		
Total % Transported	-0.5%	0.1%	0.1%	-0.3%	0.0%	-3.2%	-4.4%	-3.2%	-1.4%		
LCR Fall Chinook Inriver Survival (1 project)	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	0.0%	-0.3%	-0.2%	-0.1%		

Gap Analysis - Fall Chinook Summary Page - D=0.18		Flow Years										
Proposed Long-term Operation		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
Relative Difference (Reference/Proposed)											Geomean	
SR Fall Chinook System Survival with Mixed D		98.6%	99.5%	99.4%	99.3%	99.7%	92.0%	76.2%	92.4%	96.3%		
SR Fall Chinook System Survival w/o D		99.0%	100.0%	100.0%	99.4%	100.0%	92.6%	77.6%	93.0%	96.7%		
SR Fall Chinook Inriver Survival (without Transport)		96.3%	99.2%	99.4%	97.6%	99.1%	81.3%	49.8%	82.1%	92.1%		
LCR Fall Chinook Inriver Survival (1 project)		99.9%	99.9%	99.9%	99.8%	99.9%	100.0%	99.7%	99.8%	99.8%		99.8%
Relative Difference ((Proposed-Reference)/Reference)											Difference in means	
SR Fall Chinook System Survival with Mixed D		1.5%	0.5%	0.6%	0.7%	0.3%	8.7%	31.3%	8.2%	3.9%		
SR Fall Chinook System Survival w/o D		1.0%	0.0%	0.0%	0.6%	0.0%	8.0%	28.8%	7.6%	3.4%		
SR Fall Chinook Inriver Survival (without Transport)		3.8%	0.8%	0.6%	2.4%	0.9%	23.1%	100.9%	21.8%	8.6%		
LCR Fall Chinook Inriver Survival (1 project)		0.1%	0.1%	0.1%	0.2%	0.1%	0.0%	0.3%	0.2%	0.2%		0.2%

Figure A-10. Snake River fall chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the long term assuming D=0.18. Source: NMFS

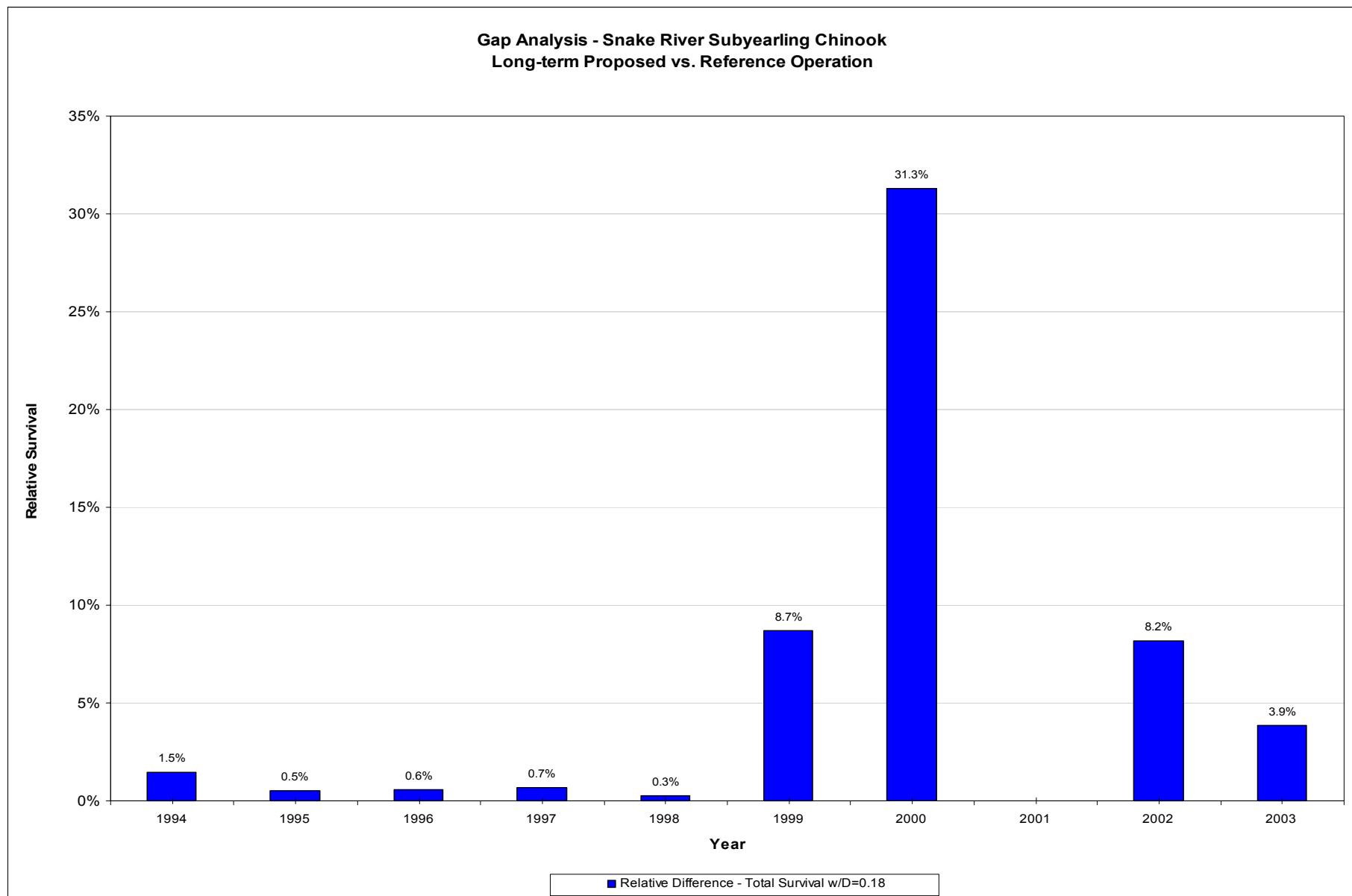


Table A-17. SIMPAS analysis results for fall chinook juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the near term assuming D=0.41. Source: NMFS staff.

Gap Analysis - Fall Chinook Summary Page - D=0.41										
Proposed Near-term Operation	Flow Years									
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
SR Fall Chinook System Survival with Mixed D	22.8%	18.8%	17.3%	19.9%	23.8%	17.9%	8.1%	19.0%	18.5%	18.5%
SR Fall Chinook System Survival w/o D	54.8%	44.9%	40.9%	47.9%	57.2%	42.9%	19.5%	45.7%	44.2%	44.2%
SR Fall Chinook Inriver Survival (without Transport)	12.3%	18.1%	21.7%	13.8%	15.9%	13.3%	6.1%	12.9%	14.3%	14.3%
Total % Transported	55.4%	45.0%	40.8%	48.4%	57.8%	43.3%	19.7%	46.2%	44.6%	44.6%
LCR Fall Chinook Inriver Survival (1 project)	78.3%	87.6%	97.3%	82.0%	85.1%	84.1%	91.6%	82.8%	86.1%	86.1%
Reference Operation										
SR Fall Chinook System Survival with Mixed D	22.5%	18.8%	17.3%	19.8%	23.8%	16.5%	6.3%	17.7%	17.8%	17.8%
SR Fall Chinook System Survival w/o D	54.2%	44.9%	41.0%	47.6%	57.2%	39.7%	15.2%	42.5%	42.8%	42.8%
SR Fall Chinook Inriver Survival (without Transport)	11.9%	17.9%	21.6%	13.5%	15.8%	10.9%	3.0%	10.6%	13.1%	13.1%
Total % Transported	54.9%	45.1%	40.9%	48.1%	57.8%	40.2%	15.4%	43.0%	43.2%	43.2%
LCR Fall Chinook Inriver Survival (1 project)	78.2%	87.5%	97.2%	81.8%	85.0%	84.1%	91.3%	82.6%	86.0%	86.0%
Absolute Difference (Reference-Proposed)										
SR Fall Chinook System Survival with Mixed D	-0.3%	0.0%	0.0%	-0.1%	0.0%	-1.3%	-1.8%	-1.4%	-0.6%	-0.6%
SR Fall Chinook System Survival w/o D	-0.6%	0.0%	0.0%	-0.3%	0.0%	-3.1%	-4.3%	-3.2%	-1.4%	-1.4%
SR Fall Chinook Inriver Survival (without Transport)	-0.5%	-0.2%	-0.1%	-0.3%	-0.1%	-2.5%	-3.1%	-2.3%	-1.1%	-1.1%
Total % Transported	-0.5%	0.1%	0.1%	-0.3%	0.0%	-3.1%	-4.3%	-3.2%	-1.4%	-1.4%
LCR Fall Chinook Inriver Survival (1 project)	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	0.0%	-0.3%	-0.2%	-0.1%	-0.1%

Gap Analysis - Fall Chinook Summary Page - D=0.41										
Proposed Near-term Operation	Flow Years									
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Relative Difference (Reference/Proposed)										Geomean
SR Fall Chinook System Survival with Mixed D	98.9%	99.9%	99.8%	99.4%	99.9%	92.5%	77.3%	92.9%	96.6%	
SR Fall Chinook System Survival w/o D	99.0%	100.0%	100.0%	99.4%	100.0%	92.7%	77.8%	93.0%	96.7%	
SR Fall Chinook Inriver Survival (without Transport)	96.3%	99.1%	99.3%	97.6%	99.1%	81.3%	49.8%	82.1%	92.0%	
LCR Fall Chinook Inriver Survival (1 project)	99.9%	99.9%	99.9%	99.8%	99.9%	100.0%	99.7%	99.8%	99.8%	
Relative Difference ((Proposed-Reference)/Reference)										Difference in means
SR Fall Chinook System Survival with Mixed D	1.2%	0.1%	0.2%	0.6%	0.1%	8.1%	29.3%	7.7%	3.5%	
SR Fall Chinook System Survival w/o D	1.0%	0.0%	0.0%	0.6%	0.0%	7.9%	28.6%	7.5%	3.4%	
SR Fall Chinook Inriver Survival (without Transport)	3.9%	0.9%	0.7%	2.4%	0.9%	23.0%	100.8%	21.8%	8.7%	
LCR Fall Chinook Inriver Survival (1 project)	0.1%	0.1%	0.1%	0.2%	0.1%	0.0%	0.3%	0.2%	0.2%	

Figure A-11. Snake River fall chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the near term assuming D=0.41. Source: NMFS staff.

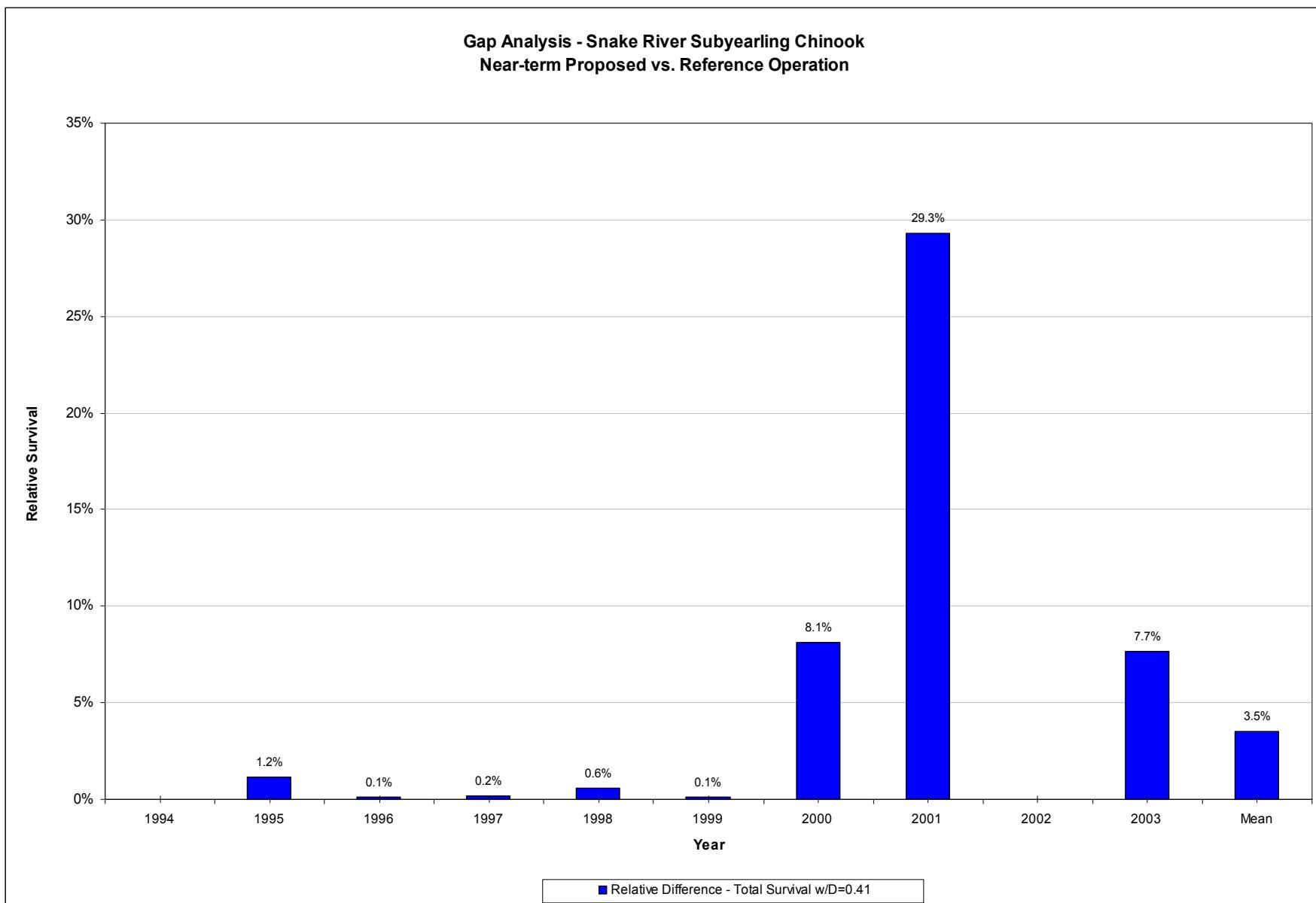


Table A-18. SIMPAS analysis results for fall chinook juvenile survival through the FCRPS from the point of ESU entry to the Bonneville Dam tailrace in the long term assuming D=0.41. Source: NMFS staff.

Gap Analysis - Fall Chinook Summary Page - D=0.41											
Proposed Long-term Operation	Flow Years										
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
SR Fall Chinook System Survival with Mixed D	23.0%	19.0%	17.6%	20.1%	24.0%	18.0%	8.2%		19.2%		18.6%
SR Fall Chinook System Survival w/o D	55.2%	45.3%	41.3%	48.3%	57.6%	43.2%	19.7%		46.1%		44.6%
SR Fall Chinook Inriver Survival (without Transport)	14.0%	20.6%	24.7%	15.7%	18.1%	15.2%	6.9%		14.6%		16.2%
Total % Transported	55.7%	45.3%	41.0%	48.7%	58.1%	43.6%	19.8%		46.5%		44.8%
LCR Fall Chinook Inriver Survival (1 project)	78.4%	87.7%	97.4%	82.1%	85.2%	84.2%	91.6%		82.9%		86.2%
Reference Operation											Mean
SR Fall Chinook System Survival with Mixed D	22.7%	19.0%	17.5%	20.0%	24.0%	16.7%	6.3%		17.8%		18.0%
SR Fall Chinook System Survival w/o D	54.6%	45.3%	41.3%	48.0%	57.6%	40.0%	15.3%		42.8%		43.1%
SR Fall Chinook Inriver Survival (without Transport)	13.5%	20.4%	24.5%	15.3%	18.0%	12.3%	3.4%		12.0%		14.9%
Total % Transported	55.2%	45.4%	41.1%	48.4%	58.1%	40.4%	15.5%		43.3%		43.4%
LCR Fall Chinook Inriver Survival (1 project)	78.3%	87.6%	97.3%	81.9%	85.1%	84.2%	91.3%		82.7%		86.1%
Absolute Difference (Reference-Proposed)											Difference in means
SR Fall Chinook System Survival with Mixed D	-0.3%	0.0%	0.0%	-0.1%	0.0%	-1.4%	-1.9%		-1.4%		-0.6%
SR Fall Chinook System Survival w/o D	-0.6%	0.0%	0.0%	-0.3%	0.0%	-3.2%	-4.4%		-3.2%		-1.5%
SR Fall Chinook Inriver Survival (without Transport)	-0.5%	-0.2%	-0.1%	-0.4%	-0.2%	-2.8%	-3.5%		-2.6%		-1.3%
Total % Transported	-0.5%	0.1%	0.1%	-0.3%	0.0%	-3.2%	-4.4%		-3.2%		-1.4%
LCR Fall Chinook Inriver Survival (1 project)	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	0.0%	-0.3%		-0.2%		-0.1%
Relative Difference (Reference/Proposed)											Geomean
SR Fall Chinook System Survival with Mixed D	98.8%	99.8%	99.8%	99.4%	99.9%	92.4%	77.2%		92.8%		96.6%
SR Fall Chinook System Survival w/o D	99.0%	100.0%	100.0%	99.4%	100.0%	92.6%	77.6%		93.0%		96.7%
SR Fall Chinook Inriver Survival (without Transport)	96.3%	99.2%	99.4%	97.6%	99.1%	81.3%	49.8%		82.1%		92.1%
LCR Fall Chinook Inriver Survival (1 project)	99.9%	99.9%	99.9%	99.8%	99.9%	100.0%	99.7%		99.8%		99.8%

Gap Analysis - Fall Chinook Summary Page - D=0.41										Flow Years	
Proposed Long-term Operation	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
Relative Difference ((Proposed-Reference)/Reference)										Difference in means	
SR Fall Chinook System Survival with Mixed D	1.2%	0.2%	0.2%	0.6%	0.1%	8.2%	29.6%			7.8%	3.5%
SR Fall Chinook System Survival w/o D	1.0%	0.0%	0.0%	0.6%	0.0%	8.0%	28.8%			7.6%	3.4%
SR Fall Chinook Inriver Survival (without Transport)	3.8%	0.8%	0.6%	2.4%	0.9%	23.1%	100.9%			21.8%	8.6%
LCR Fall Chinook Inriver Survival (1 project)	0.1%	0.1%	0.1%	0.2%	0.1%	0.0%	0.3%			0.2%	0.2%

Figure A-12. Snake River fall chinook juvenile FCRPS system passage survival effects (reference minus proposed action divided by reference) of the proposed action in the long term assuming D=0.41. Source: NMFS staff.

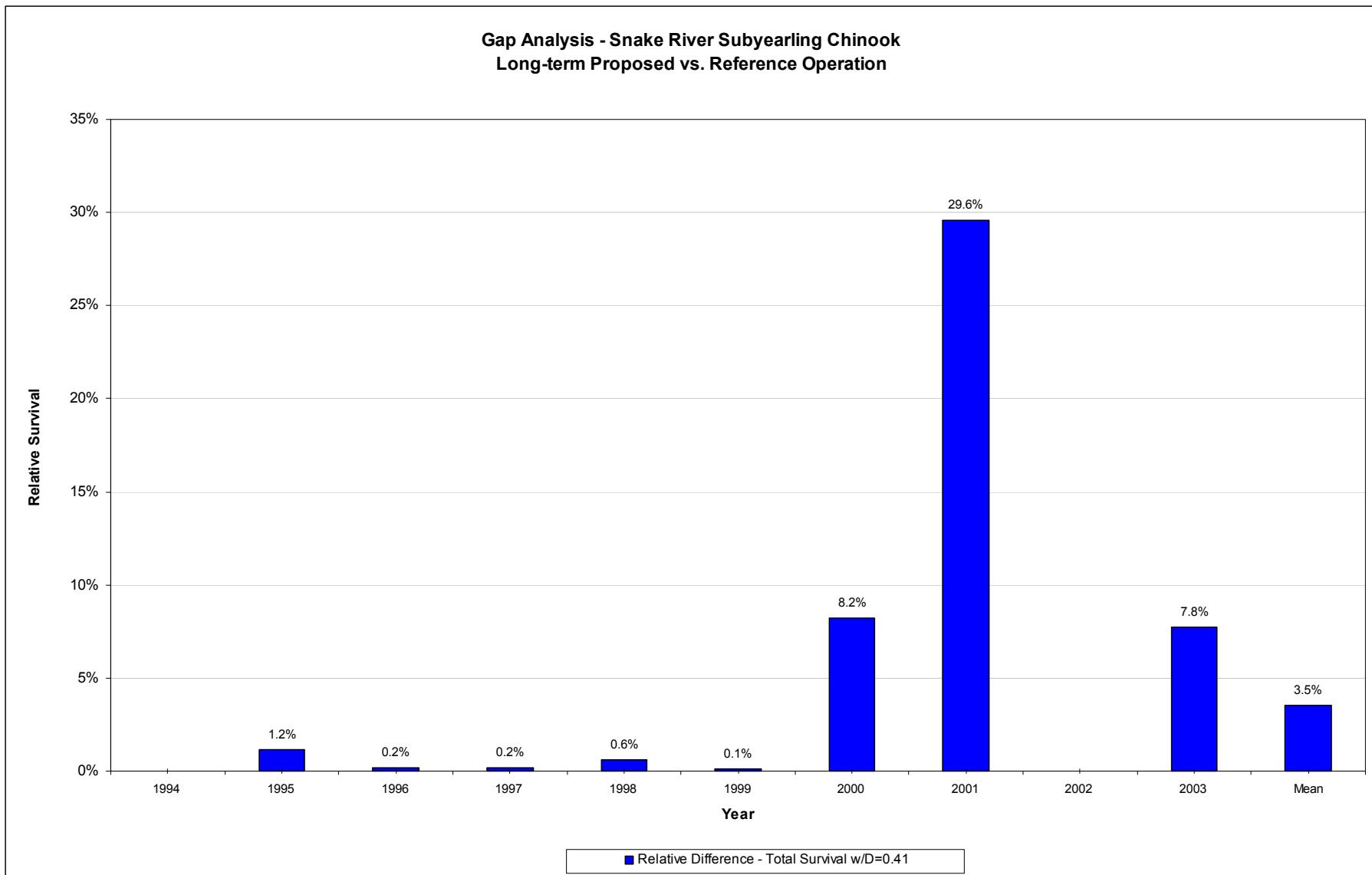


Figure A-13. Estimated daily average water temperatures at Lower Granite Dam during 2000 (low water year) under the reference operation and the proposed action. Source: EPA 2005

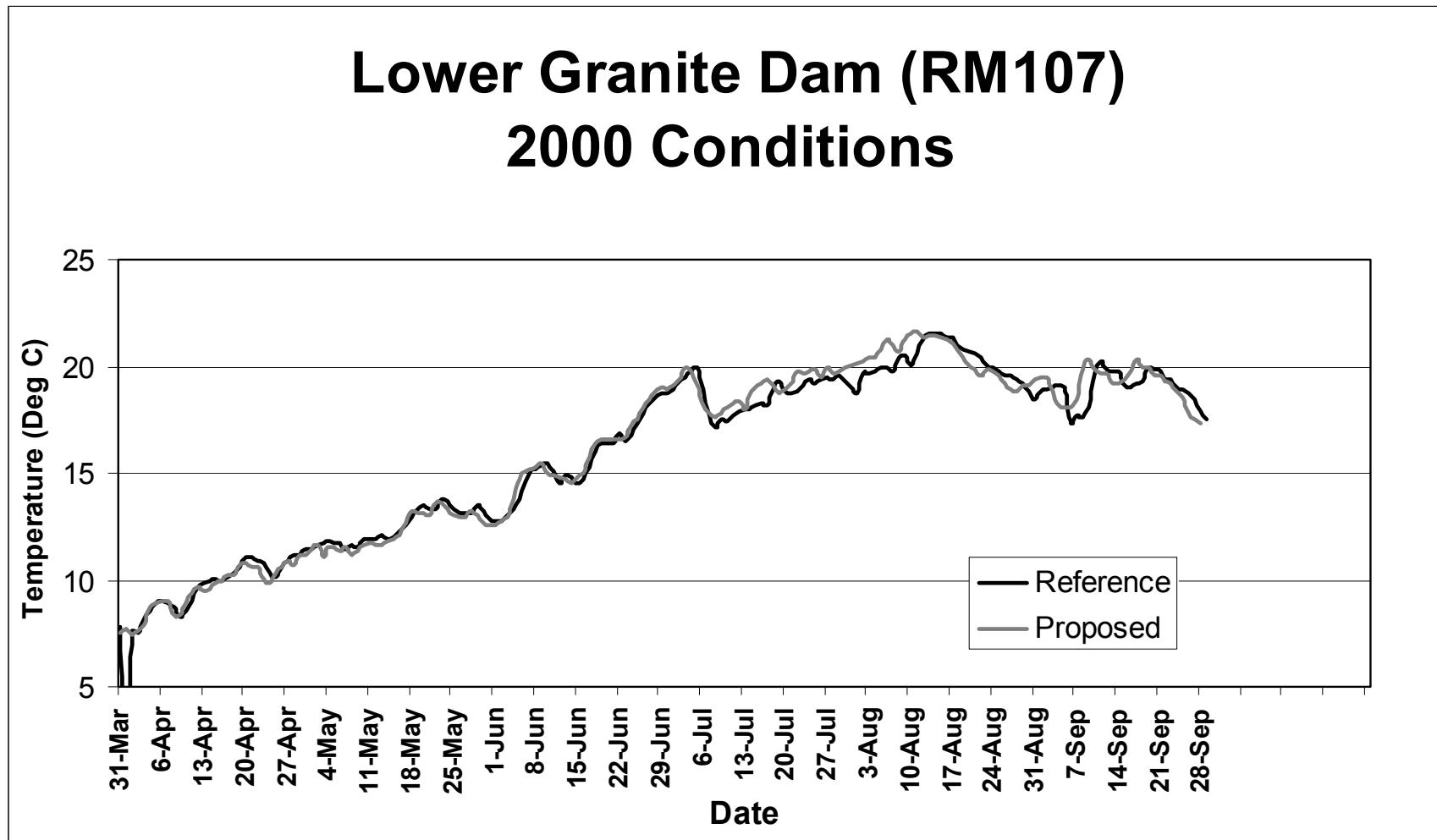


Figure A-14. Estimated daily average water temperatures at Lower Granite Dam during 1995 (average water year) under the reference operation and the proposed action. Source: EPA 2005.

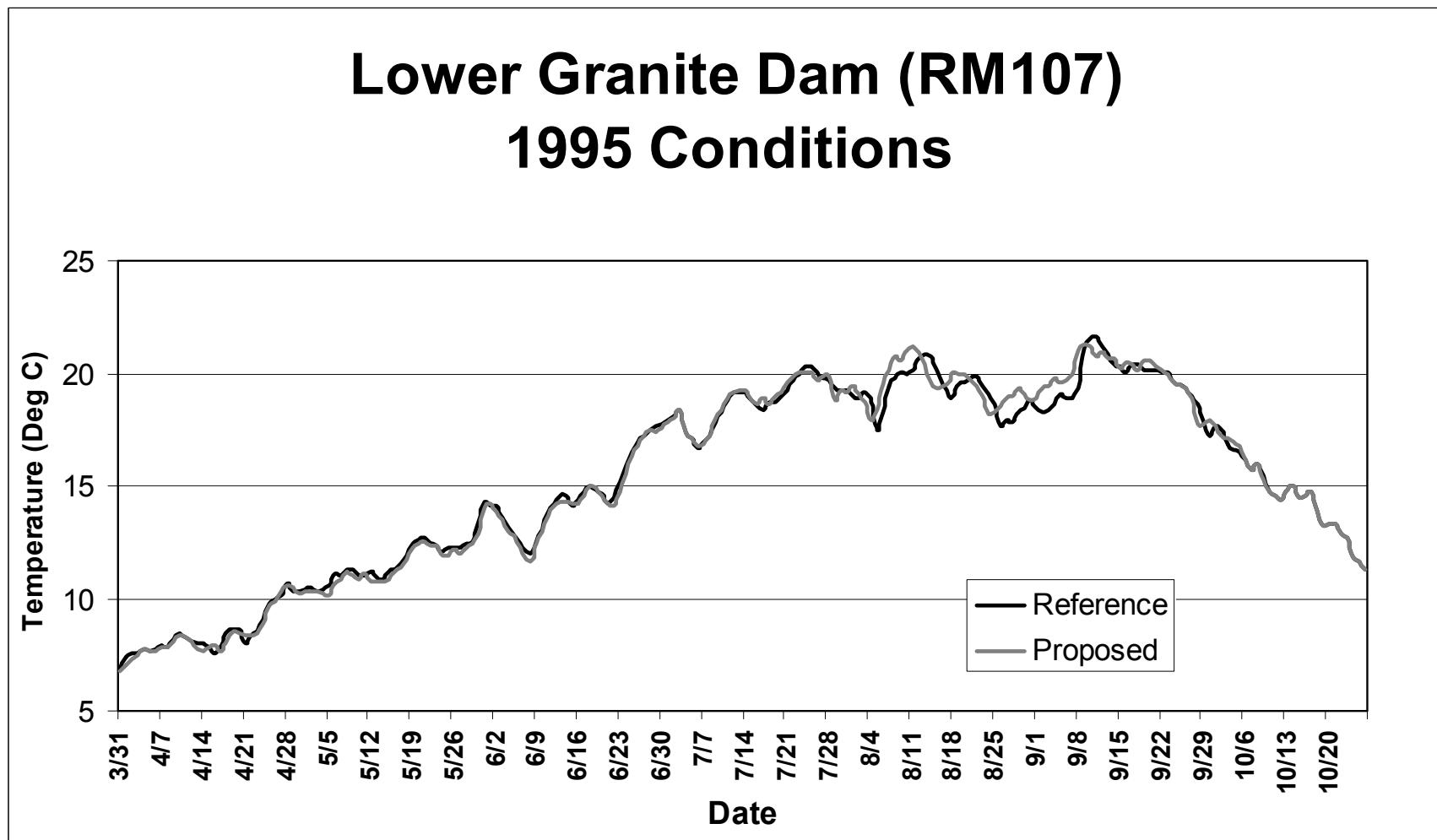


Figure A-15. Estimated daily average water temperatures at Lower Granite Dam during 1997 (high water year) under the reference operation and the proposed action. Source: EPA 2005.

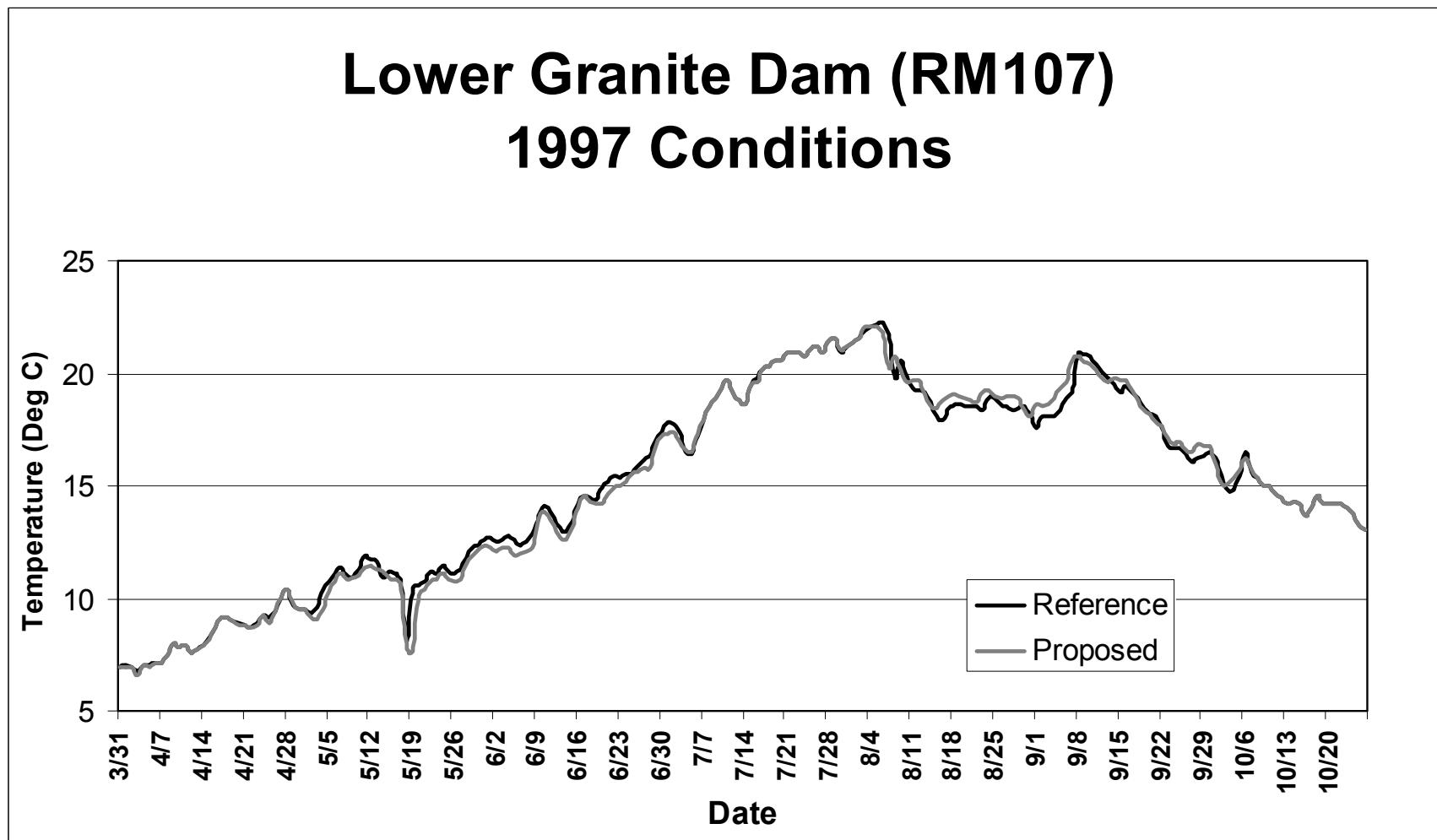


Figure A-16. Estimated daily average water temperatures at Ice Harbor Dam during 2000 (low water year) under the reference operation and the proposed action. Source: EPA 2005.

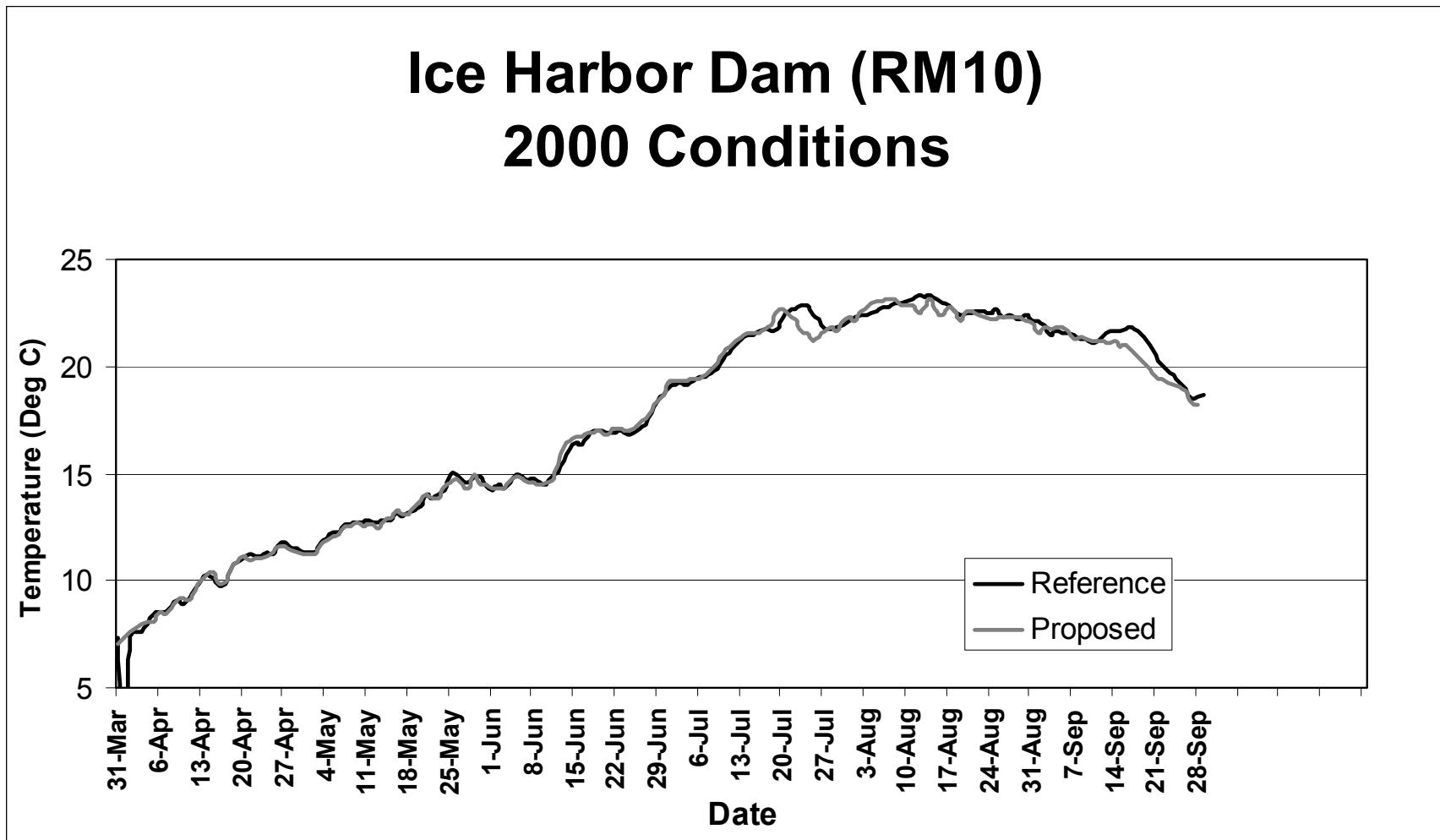


Figure A-17. Estimated daily average water temperatures at Ice Harbor Dam during 1995 (average water year) under the reference operation and the proposed action. Source: EPA 2005.

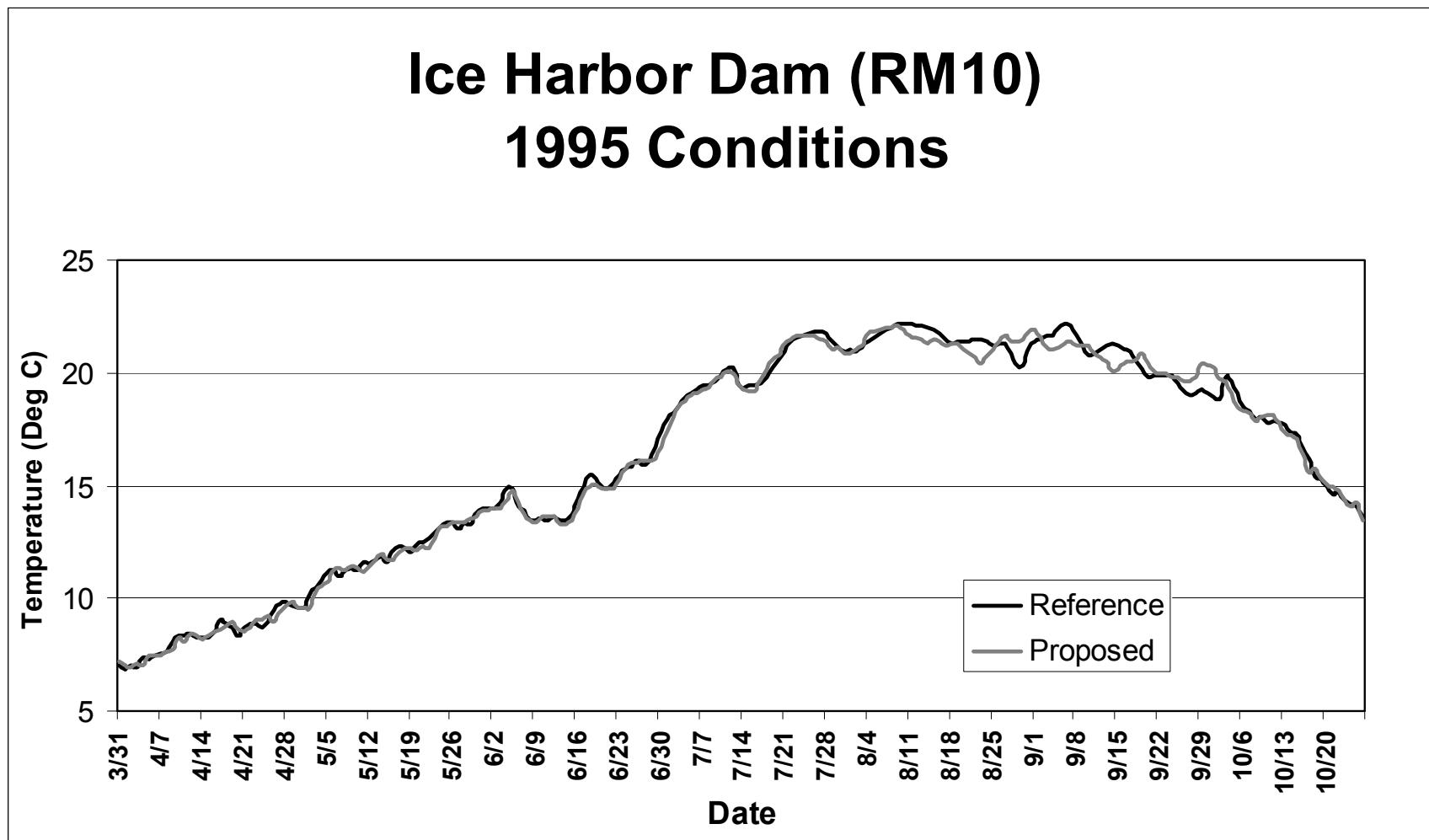


Figure A-18. Estimated daily average water temperatures at Ice Harbor Dam during 1997 (high water year) under the reference operation and the proposed action. Source: EPA 2005.

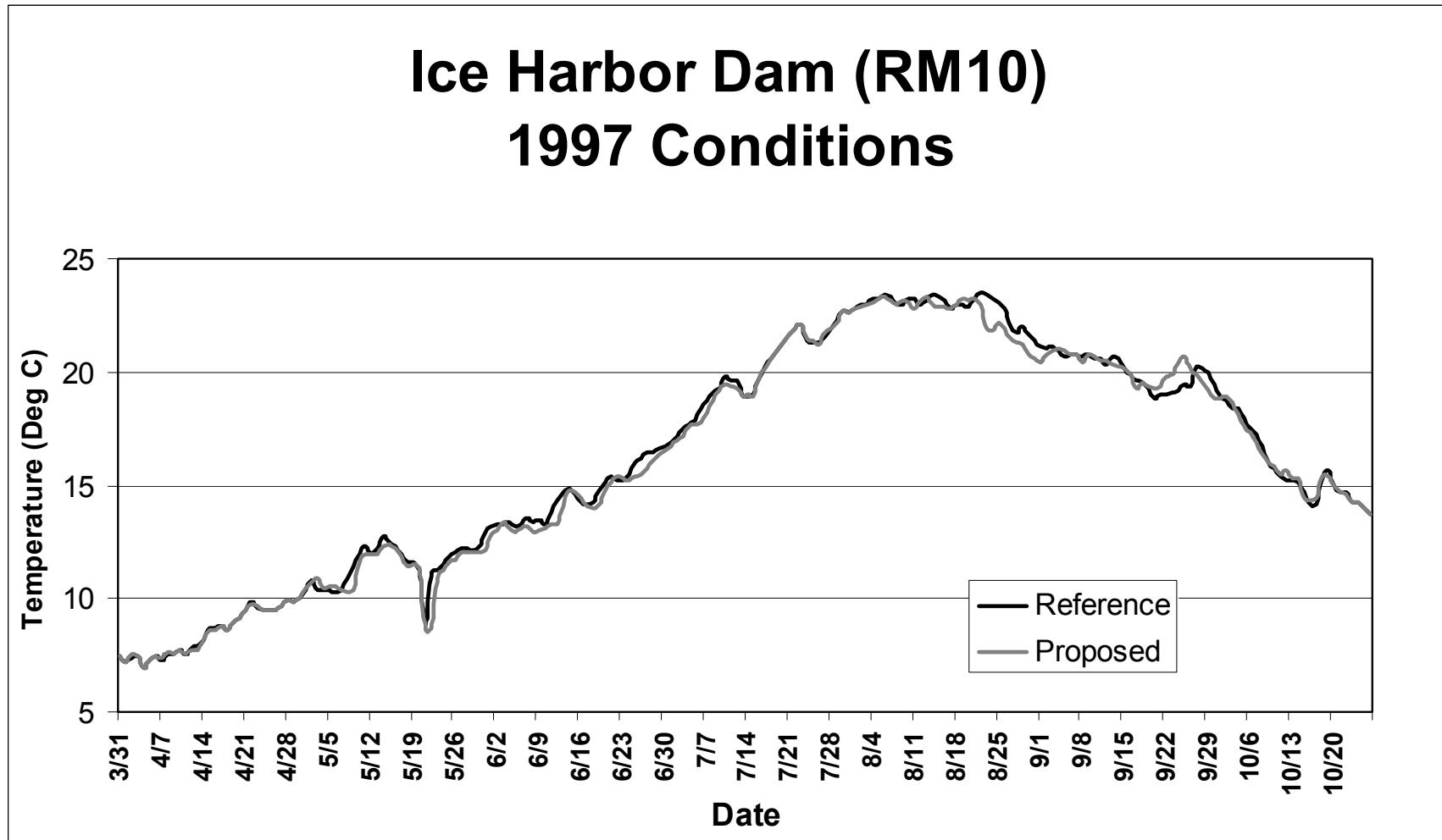


Figure A-19. Estimated daily average water temperatures at McNary Dam during 2000 (low water year) under the reference operation and the proposed action. Source: EPA 2005.

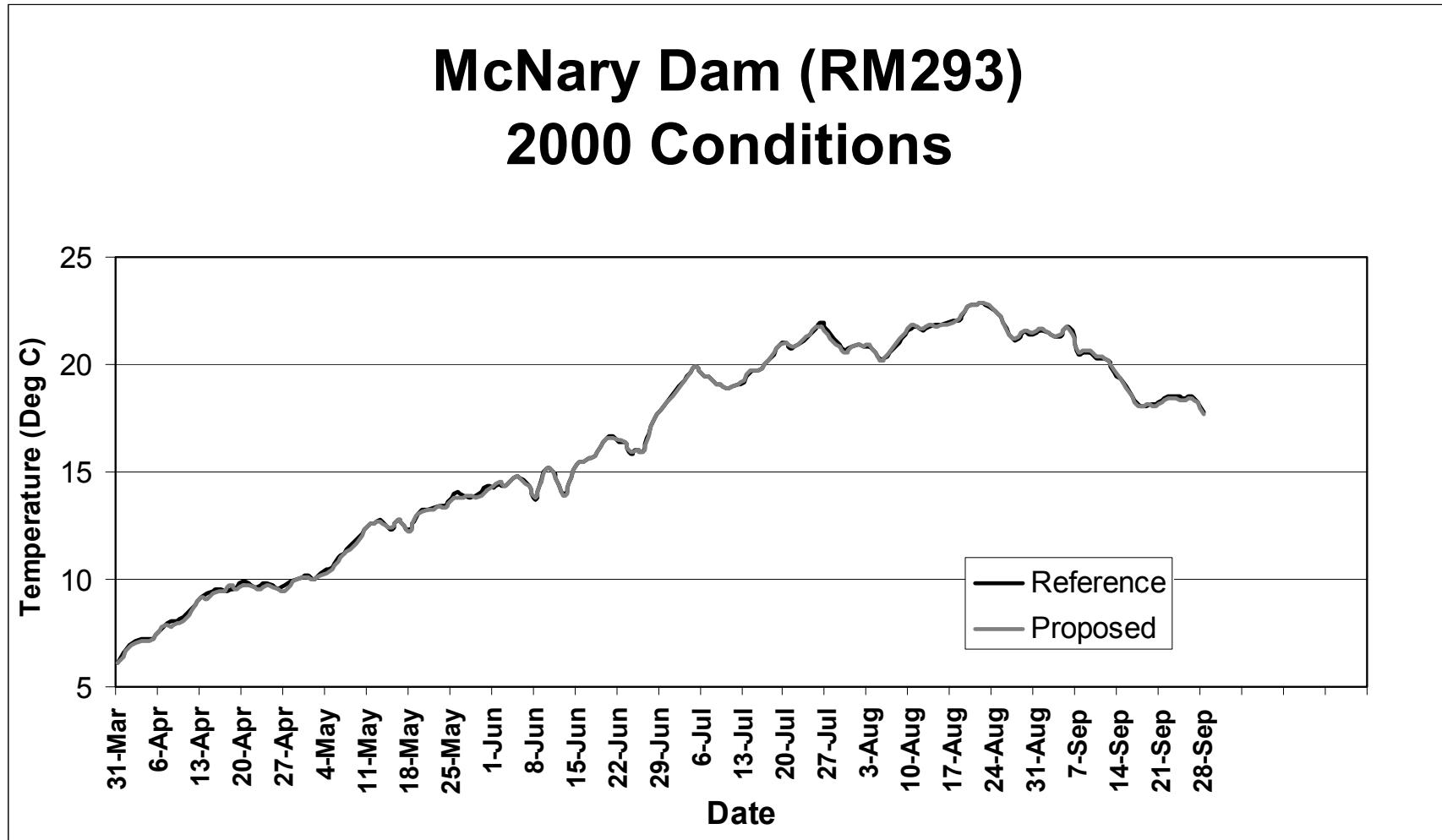


Figure A-20. Estimated daily average water temperatures at McNary Dam during 1995 (average water year) under the reference operation and the proposed action. Source: EPA 2005.

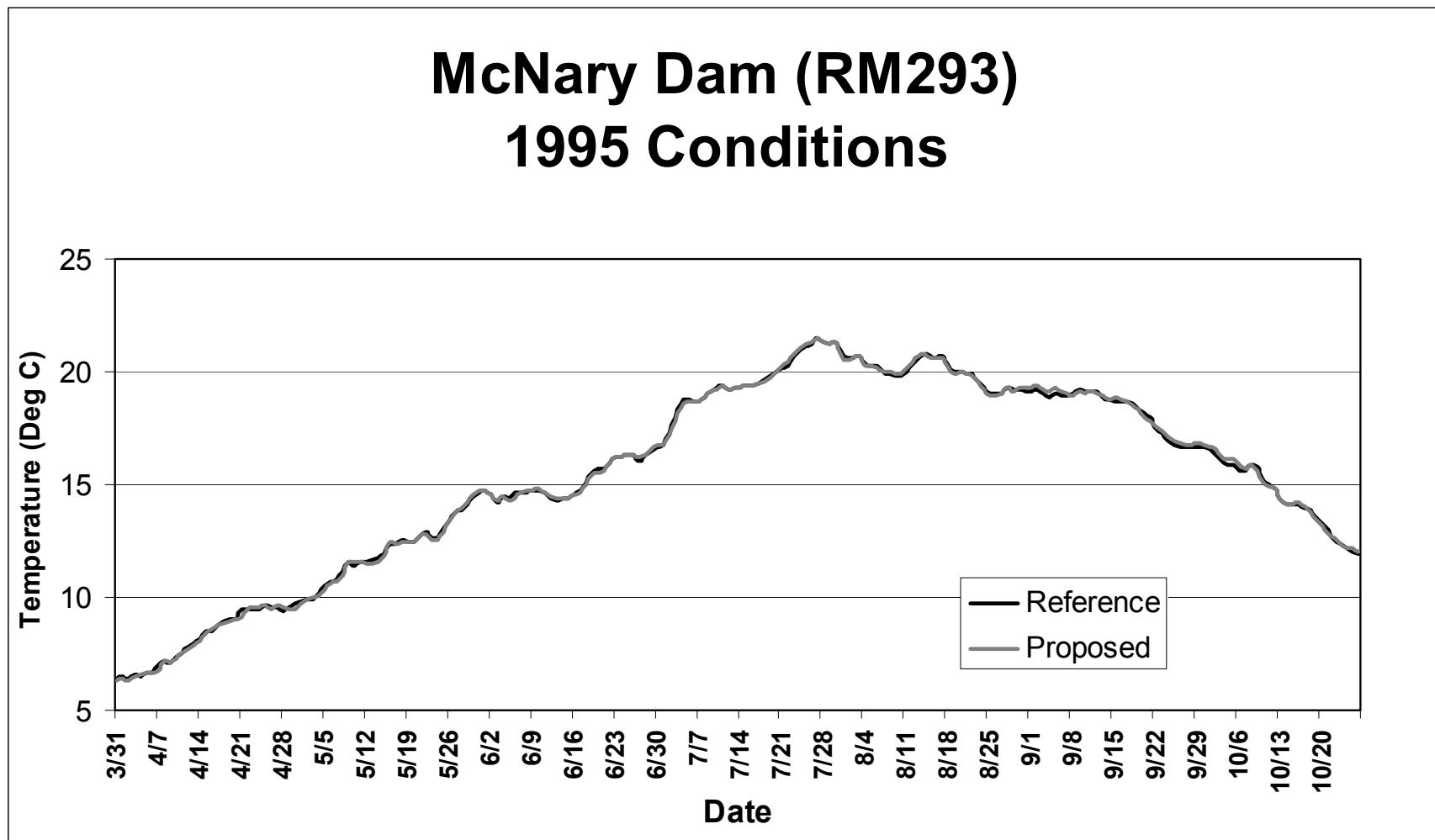


Figure A-21. Estimated daily average water temperatures at McNary Dam during 1997 (high water year) under the reference operation and the proposed action. Source: EPA 2005.

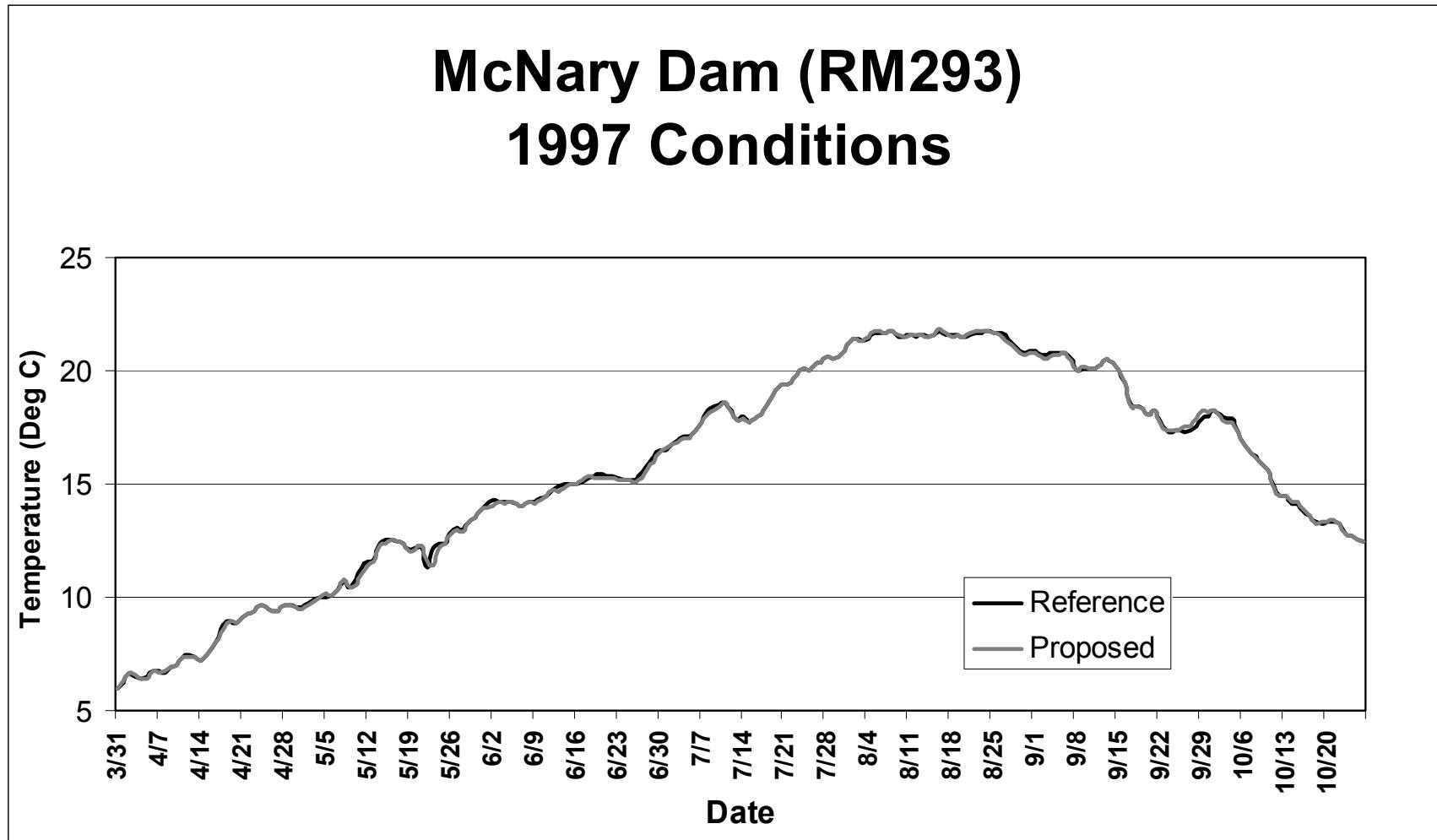


Figure A-22. Estimated daily average water temperatures at Lower Granite Dam during 2000 (low water year) under the reference operation and the proposed action. Source: Corps 2005.

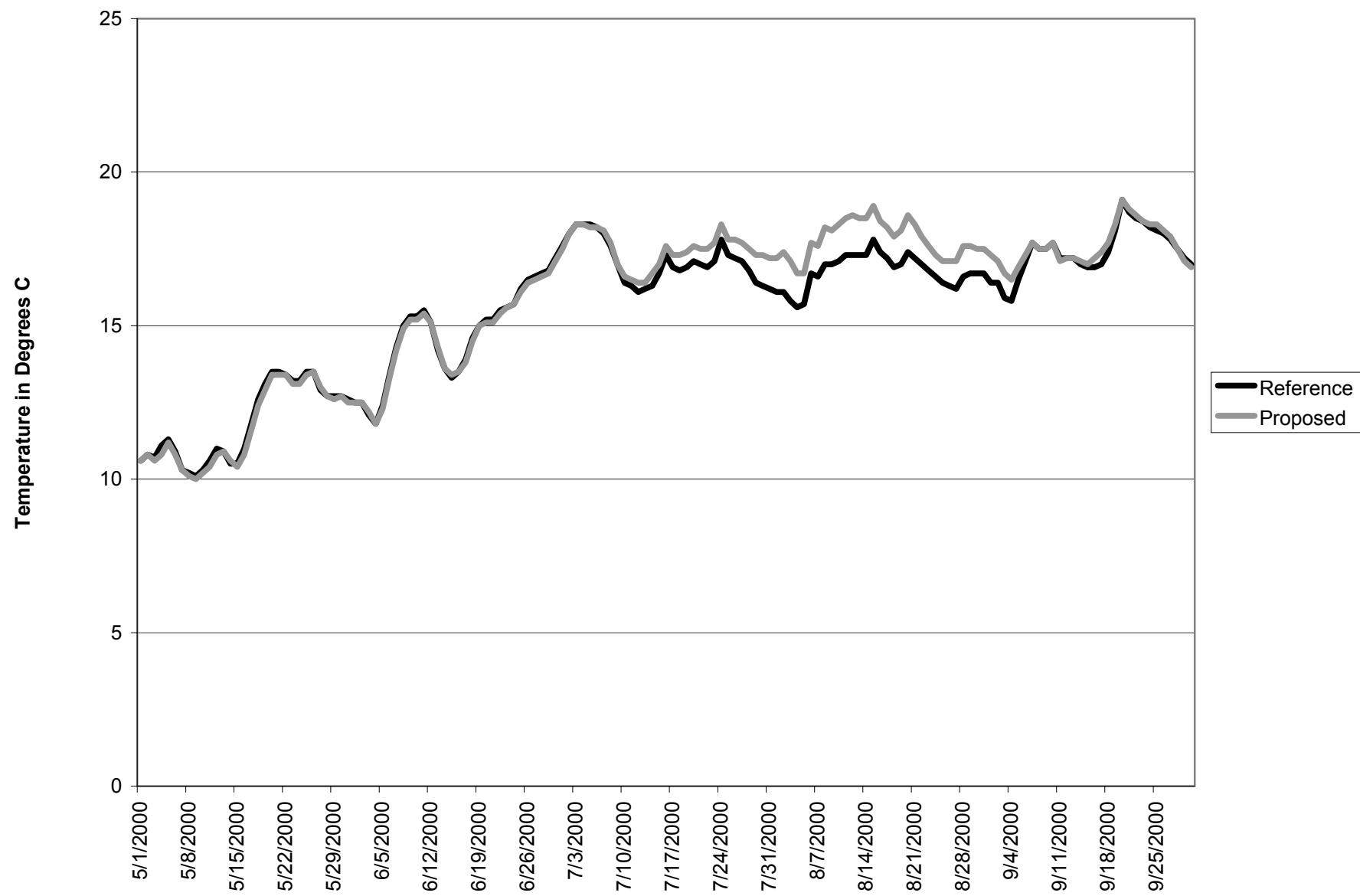


Figure A-23. Estimated daily average water temperatures at Lower Granite Dam during 1995 (average water year) under the reference operation and the proposed action. Source: Corps 2005.

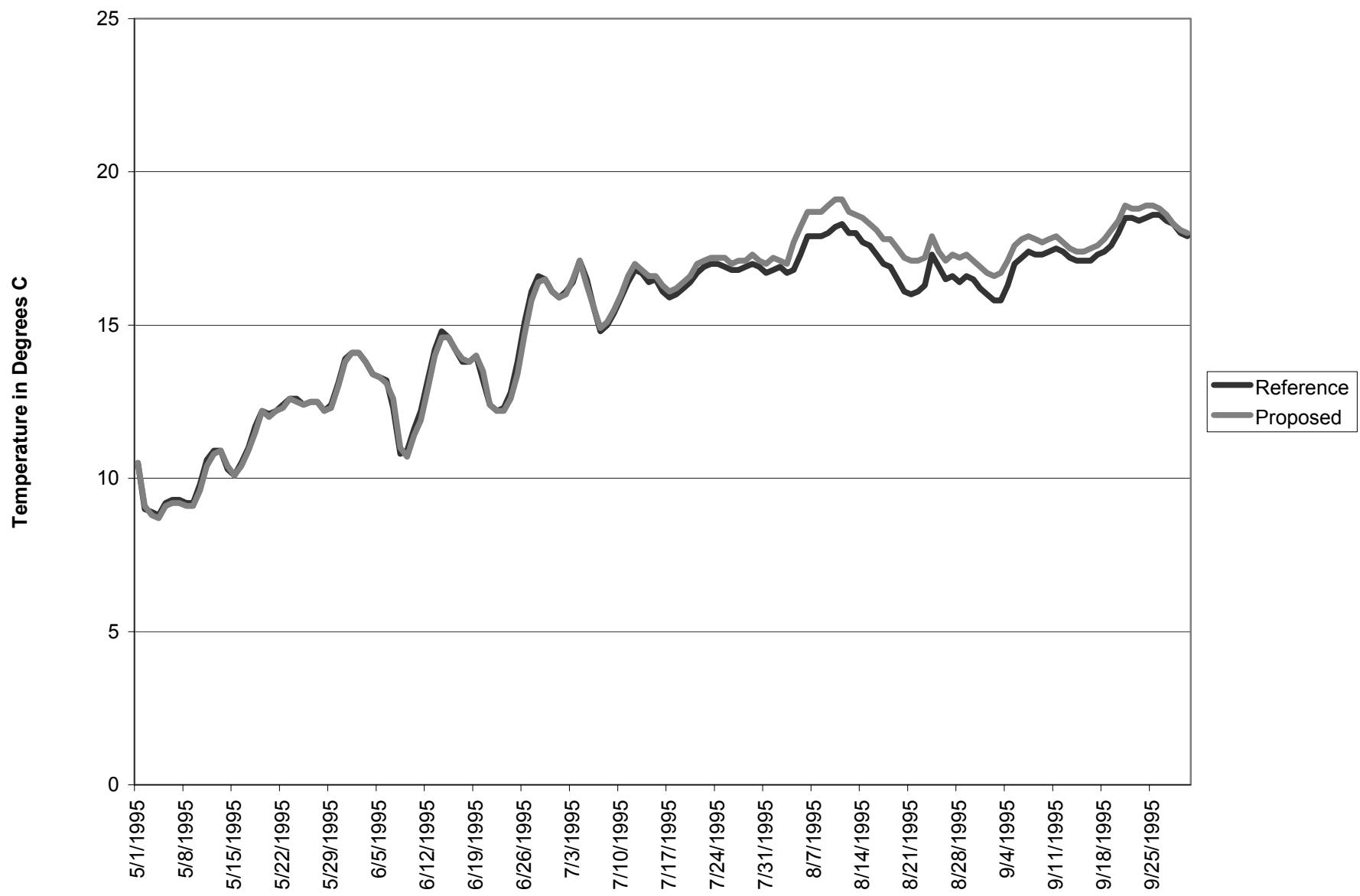


Figure A-24. Estimated daily average water temperatures at Lower Granite Dam during 1997 (high water year) under the reference operation and the proposed action. Source: Corps 2005.

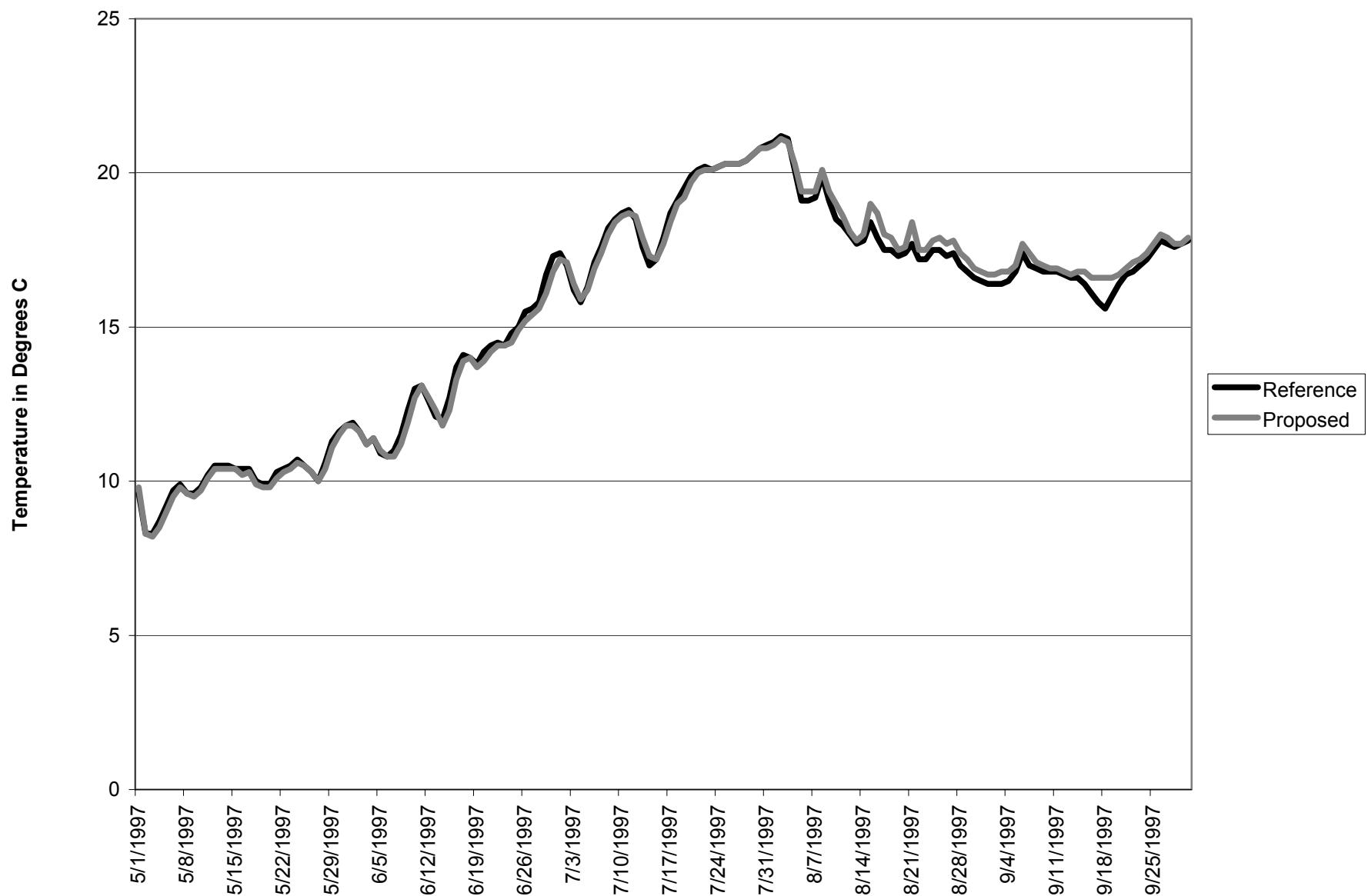


Table A-19. Simulated involuntary spills at Lower Granite Dam under the reference operation and the frequency that those spills would exceed the 43 kcfs spill cap. Source: Raw data, BPA HYDSIM model run FRIII_USNBIOP04.xls, Spill cap exceedence analysis, NMFS staff.

Reference Operation

520
LR.GRN

0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(68.9)	29	0	0	0	0	0	0	0	0	0	0	0	0	0
(70.2)	30	0	0	0	0	0	0	0	0	0	0	0	0	0
(64.5)	31	0	0	0	0	0	0	0	0	0	0	0	0	0
(106.7)	32	0	0	0	0	0	0	0	0	18926	5688	39188	13582	0
(108.4)	33	0	0	0	0	0	0	0	0	0	0	0	56279	0
(110.6)	34	0	0	0	0	0	0	0	0	650	0	0	0	0
(91.0)	35	0	0	0	0	0	0	0	0	0	0	0	0	0
(89.5)	36	0	0	0	0	0	0	0	0	0	60310	43018	0	0
(69.4)	37	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	38	0	0	0	0	0	0	0	0	6536	13460	27835	25549	0
(81.3)	39	0	0	0	0	0	0	0	0	0	0	0	0	0
(81.7)	40	0	0	0	0	0	0	0	0	0	0	0	0	0
(69.9)	41	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	42	0	0	0	0	0	0	0	0	242	1016	0	2135	0
(118.5)	43	0	0	0	0	0	0	0	0	75424	70723	19497	53923	2611
(60.3)	44	0	0	0	0	0	0	0	0	0	0	0	0	0
(83.3)	45	0	0	0	0	0	0	0	0	0	0	13670	12114	0
(111.8)	46	0	0	0	0	0	0	0	0	14264	28173	21507	0	0
(106.7)	47	0	0	0	0	0	0	0	0	0	0	40186	257	0
(131.4)	48	0	0	0	0	0	0	0	0	0	9617	66885	74311	0
(102.5)	49	0	0	0	0	0	0	0	0	18972	18236	56804	0	0
(124.9)	50	0	0	0	0	0	0	0	0	8648	0	10342	57226	0
(125.0)	51	0	0	0	0	0	0	0	0	23422	9288	26999	6376	0
(113.5)	52	0	0	0	0	0	0	0	0	67610	77568	85857	21583	0
(106.8)	53	0	0	0	0	0	0	0	0	0	0	0	60627	0
(118.3)	54	0	0	0	0	0	0	0	0	0	0	18032	0	0
(96.9)	55	0	0	0	0	0	0	0	0	0	0	0	23641	0
(141.0)	56	0	0	0	0	0	0	0	0	14472	55871	68808	51881	0
(112.7)	57	0	0	0	0	0	0	0	0	8935	0	86108	38517	0
(107.6)	58	0	0	0	0	0	0	0	0	0	15677	65681	6609	0

Reference Operation

520

LR.GRN

0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(118.8)	59	0	0	0	0	0	0	0	0	0	0	0	23047	0
(102.5)	60	0	0	0	0	0	0	0	0	12891	0	0	0	0
(111.4)	61	0	0	0	0	0	0	0	0	0	0	0	0	0
(97.2)	62	0	0	0	0	0	0	0	0	16659	14434	806	8743	0
(94.7)	63	0	0	0	0	0	0	0	0	0	0	0	13394	0
(107.3)	64	0	0	0	0	0	0	0	0	3028	0	7591	76394	0
(126.1)	65	0	0	0	0	0	0	0	0	0	39362	40723	78200	0
(89.3)	66	0	0	0	0	0	0	0	0	0	0	0	0	0
(113.7)	67	0	0	0	0	0	0	0	0	0	0	7087	57807	0
(95.5)	68	0	0	0	0	0	0	0	0	0	0	0	4805	0
(122.4)	69	0	0	0	0	0	0	0	0	29481	27873	49613	0	0
(90.0)	70	0	0	0	0	0	0	0	0	0	0	0	20292	61956
(138.9)	71	0	0	0	0	0	0	0	0	15893	2506	86119	92033	0
(152.5)	72	0	0	0	0	0	0	0	60092	7092	0	63680	88080	0
(71.2)	73	0	0	0	0	0	0	0	0	0	0	0	0	0
(156.9)	74	0	0	0	0	0	0	0	3841	22189	34440	50130	123589	0
(111.9)	75	0	0	0	0	0	0	0	0	0	0	0	18530	94193
(122.7)	76	0	0	0	0	0	0	0	0	42028	5611	63098	27488	0
(53.8)	77	0	0	0	0	0	0	0	0	0	0	0	0	0
(104.7)	78	0	0	0	0	0	0	0	0	3562	0	8767	26577	0
Average	0	0	0	0	0	0	0	0	1279	8218	9797	22137	25618	290
Maximum									60092	75424	77568	86119	123589	11906
Spills in excess of 43 kcfs									1	2	2	12	14	0

Table A-20. Simulated involuntary spills at Lower Granite Dam under the proposed action and the frequency that those spills would exceed the 43 kcfs spill cap. Source: Raw data, BPA HYDSIM model run FRIII_USNBIOP04.xls, Spill cap exceedence analysis, NMFS staff.

Proposed Action

520 LR.GRN

FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(68.9)	29	0	0	0	0	0	0	0	0	0	0	0	0	0
(70.2)	30	0	0	0	0	0	0	0	0	0	0	0	0	0
(64.5)	31	0	0	0	0	0	0	0	0	0	0	0	0	0
(106.7)	32	0	0	0	0	0	0	0	0	7260	0	14917	0	0
(108.4)	33	0	0	0	0	0	0	0	0	0	0	0	43498	0
(110.6)	34	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	35	0	0	0	0	0	0	0	0	0	0	0	0	0
(89.5)	36	0	0	0	0	0	0	0	0	0	42208	12576	0	0
(69.4)	37	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	38	0	0	0	0	0	0	0	0	0	5032	8750	9963	0
(81.3)	39	0	0	0	0	0	0	0	0	0	0	0	0	0
(81.7)	40	0	0	0	0	0	0	0	0	0	0	0	0	0
(69.9)	41	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	42	0	0	0	0	0	0	0	0	0	0	0	0	0
(118.5)	43	0	0	0	0	0	0	0	0	67896	63501	1808	32179	1179
(60.3)	44	0	0	0	0	0	0	0	0	0	0	0	0	0
(83.3)	45	0	0	0	0	0	0	0	0	0	0	0	398	0
(111.8)	46	0	0	0	0	0	0	0	0	7683	21747	6652	0	0
(106.7)	47	0	0	0	0	0	0	0	0	0	0	25684	0	0
(131.4)	48	0	0	0	0	0	0	0	0	0	3135	54674	66535	0
(102.5)	49	0	0	0	0	0	0	0	0	7087	6629	43761	0	0
(124.9)	50	0	0	0	0	0	0	0	0	4109	0	0	38209	0
(125.0)	51	0	0	0	0	0	0	0	0	16631	2656	7829	0	0
(113.5)	52	0	0	0	0	0	0	0	0	59992	70262	64583	12963	0
(106.8)	53	0	0	0	0	0	0	0	0	0	0	0	44819	0
(118.3)	54	0	0	0	0	0	0	0	0	0	0	4659	0	0
(96.9)	55	0	0	0	0	0	0	0	0	0	0	0	17048	0
(141.0)	56	0	0	0	0	0	0	0	0	11671	53188	44635	35691	0
(112.7)	57	0	0	0	0	0	0	0	0	9577	0	70213	23143	0

Proposed Action

520 LR.GRN

FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(107.6)	58	0	0	0	0	0	0	0	0	0	12665	48952	1953	0
(118.8)	59	0	0	0	0	0	0	0	0	0	0	0	16729	0
(102.5)	60	0	0	0	0	0	0	0	0	8345	0	0	0	0
(111.4)	61	0	0	0	0	0	0	0	0	0	0	0	0	0
(97.2)	62	0	0	0	0	0	0	0	0	9109	7061	0	0	0
(94.7)	63	0	0	0	0	0	0	0	0	0	0	0	5312	0
(107.3)	64	0	0	0	0	0	0	0	0	0	0	0	63946	0
(126.1)	65	0	0	0	0	0	0	0	0	0	36064	22541	55142	0
(89.3)	66	0	0	0	0	0	0	0	0	0	0	0	0	0
(113.7)	67	0	0	0	0	0	0	0	0	0	0	0	41227	0
(95.5)	68	0	0	0	0	0	0	0	0	0	0	0	0	0
(122.4)	69	0	0	0	0	0	0	0	0	15647	14363	36755	0	0
(90.0)	70	0	0	0	0	0	0	0	0	0	0	10040	44712	0
(138.9)	71	0	0	0	0	0	0	0	0	17611	4184	64359	64558	0
(152.5)	72	0	0	0	0	0	0	0	62174	3782	0	46669	65245	0
(71.2)	73	0	0	0	0	0	0	0	0	0	0	0	0	0
(156.9)	74	0	0	0	0	0	0	0	7868	24272	36474	33459	94837	0
(111.9)	75	0	0	0	0	0	0	0	0	0	0	8214	71135	9724
(122.7)	76	0	0	0	0	0	0	0	0	40192	3817	42595	18339	0
(53.8)	77	0	0	0	0	0	0	0	0	0	0	0	0	0
(104.7)	78	0	0	0	0	0	0	0	0	0	0	0	5940	0
Average	0	0	0	0	0	0	0	0	1401	6217	7660	13487	17470	218
Maximum									62174	67896	70262	70213	94837	9724
Spills in excess of 43 kcfs									1	2	2	8	10	0

Table A-21. Simulated involuntary spills at Lower Monumental Dam under the reference operation and the frequency that those spills would exceed the 44 kcfs spill cap. Source: Raw data, BPA HYDSIM model run FRIII_USNBIOP04.xls, Spill cap exceedence analysis, NMFS staff.

Reference Operation

504 LR MON

	0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(68.9)	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(70.2)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(64.5)	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(106.7)	32	0	0	0	0	0	0	0	0	0	11134	3668	40350	1016	0
(108.4)	33	0	0	0	0	0	0	0	0	0	0	0	0	41784	0
(110.6)	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(89.5)	36	0	0	0	0	0	0	0	0	0	0	58286	44329	0	0
(69.4)	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	38	0	0	0	0	0	0	0	0	0	0	11527	29303	12448	0
(81.3)	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(81.7)	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(69.9)	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(118.5)	43	0	0	0	0	0	0	0	0	0	65480	68338	21276	39516	0
(60.3)	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(83.3)	45	0	0	0	0	0	0	0	0	0	0	0	15779	0	0
(111.8)	46	0	0	0	0	0	0	0	0	0	6316	25848	23211	0	0
(106.7)	47	0	0	0	0	0	0	0	0	0	0	0	41245	0	0
(131.4)	48	0	0	0	0	0	0	0	0	0	0	7828	67746	59624	0
(102.5)	49	0	0	0	0	0	0	0	0	0	11022	16094	57883	0	0
(124.9)	50	0	0	0	0	0	0	0	0	0	1140	0	12363	42800	0
(125.0)	51	0	0	0	0	0	0	0	0	0	15434	7114	28351	0	0
(113.5)	52	0	0	0	0	0	0	0	0	0	57839	75395	87214	8646	0
(106.8)	53	0	0	0	0	0	0	0	0	0	0	0	0	46274	0
(118.3)	54	0	0	0	0	0	0	0	0	0	0	0	19778	0	0
(96.9)	55	0	0	0	0	0	0	0	0	0	0	0	0	10344	0
(141.0)	56	0	0	0	0	0	0	0	0	0	6441	53597	69721	37713	0
(112.7)	57	0	0	0	0	0	0	0	0	0	1517	0	87154	25071	0
(107.6)	58	0	0	0	0	0	0	0	0	0	0	13764	66909	0	0
(118.8)	59	0	0	0	0	0	0	0	0	0	0	0	0	9868	0

(102.5)	60	0	0	0	0	0	0	0	0	5510	0	0	0	0
(111.4)	61	0	0	0	0	0	0	0	0	0	0	0	0	0
(97.2)	62	0	0	0	0	0	0	0	0	5912	13677	5089	0	0
(94.7)	63	0	0	0	0	0	0	0	0	0	0	2037	414	0
(107.3)	64	0	0	0	0	0	0	0	0	0	0	10372	63060	0
(126.1)	65	0	0	0	0	0	0	0	0	0	30384	44532	66832	0
(89.3)	66	0	0	0	0	0	0	0	0	0	0	0	0	0
(113.7)	67	0	0	0	0	0	0	0	0	0	0	9349	45854	0
(95.5)	68	0	0	0	0	0	0	0	0	0	0	0	0	0
(122.4)	69	0	0	0	0	0	0	0	0	23533	26797	48898	0	0
(90.0)	70	0	0	0	0	0	0	0	0	0	0	20836	46513	0
(138.9)	71	0	0	0	0	0	0	0	0	7459	0	84025	76269	0
(152.5)	72	0	0	0	0	0	0	0	40929	0	0	63242	72028	0
(71.2)	73	0	0	0	0	0	0	0	0	0	0	0	0	0
(156.9)	74	0	0	0	0	0	0	0	0	15165	31609	53111	108233	0
(111.9)	75	0	0	0	0	0	0	0	0	0	0	19298	78487	0
(122.7)	76	0	0	0	0	0	0	0	0	35817	5889	66773	14716	0
(53.8)	77	0	0	0	0	0	0	0	0	0	0	0	0	0
(104.7)	78	0	0	0	0	0	0	0	0	0	0	13156	14658	0
Average		0	0	0	0	0	0	0	819	5394	8996	23067	18443	0
Maximum		0	0	0	0	0	0	0	40929	65480	75395	87214	108233	0
Spills in excess of 44 kcfs														
cap									0	2	2	13	10	0

Table A-22. Simulated involuntary spills at Lower Monumental Dam under the proposed action and the frequency that those spills would exceed the 44 kcfs spill cap. Source: Raw data, BPA HYDSIM model run FRIII_USNBIOP04.xls, Spill cap exceedence analysis, NMFS staff.

Proposed Action

504 LR MON

	0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(68.9)	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(70.2)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(64.5)	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(106.7)	32	0	0	0	0	0	0	0	0	0	0	0	16317	0	0
(108.4)	33	0	0	0	0	0	0	0	0	0	0	0	0	29053	0
(110.6)	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(89.5)	36	0	0	0	0	0	0	0	0	0	0	39828	14109	0	0
(69.4)	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	38	0	0	0	0	0	0	0	0	0	0	3193	10399	0	0
(81.3)	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(81.7)	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(69.9)	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(118.5)	43	0	0	0	0	0	0	0	0	0	58128	60973	3751	18013	0
(60.3)	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(83.3)	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(111.8)	46	0	0	0	0	0	0	0	0	0	0	19496	8496	0	0
(106.7)	47	0	0	0	0	0	0	0	0	0	0	0	26885	0	0
(131.4)	48	0	0	0	0	0	0	0	0	0	0	1417	55277	51728	0
(102.5)	49	0	0	0	0	0	0	0	0	0	0	4618	44565	0	0
(124.9)	50	0	0	0	0	0	0	0	0	0	0	0	0	23892	0
(125.0)	51	0	0	0	0	0	0	0	0	0	8851	555	9363	0	0
(113.5)	52	0	0	0	0	0	0	0	0	0	50397	67943	65486	140	0
(106.8)	53	0	0	0	0	0	0	0	0	0	0	0	0	30430	0
(118.3)	54	0	0	0	0	0	0	0	0	0	0	0	6530	0	0
(96.9)	55	0	0	0	0	0	0	0	0	0	0	0	0	3839	0
(141.0)	56	0	0	0	0	0	0	0	0	0	3726	50861	45038	21735	0
(112.7)	57	0	0	0	0	0	0	0	0	0	2136	0	70918	9906	0
(107.6)	58	0	0	0	0	0	0	0	0	0	0	10786	49827	0	0
(118.8)	59	0	0	0	0	0	0	0	0	0	0	0	0	3634	0

Proposed Action

504 LR MON

0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(102.5)	60	0	0	0	0	0	0	0	0	1111	0	0	0	0
(111.4)	61	0	0	0	0	0	0	0	0	0	0	0	0	0
(97.2)	62	0	0	0	0	0	0	0	0	0	6387	0	0	0
(94.7)	63	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	64	0	0	0	0	0	0	0	0	0	0	0	50420	0
(126.1)	65	0	0	0	0	0	0	0	0	0	27125	26494	43420	0
(89.3)	66	0	0	0	0	0	0	0	0	0	0	0	0	0
(113.7)	67	0	0	0	0	0	0	0	0	0	0	0	29300	0
(95.5)	68	0	0	0	0	0	0	0	0	0	0	0	0	0
(122.4)	69	0	0	0	0	0	0	0	0	10124	13445	35914	0	0
(90.0)	70	0	0	0	0	0	0	0	0	0	0	10679	29228	0
(138.9)	71	0	0	0	0	0	0	0	0	9125	1308	61798	48367	0
(152.5)	72	0	0	0	0	0	0	0	42958	0	0	45871	48839	0
(71.2)	73	0	0	0	0	0	0	0	0	0	0	0	0	0
(156.9)	74	0	0	0	0	0	0	0	0	17184	33619	36292	78978	0
(111.9)	75	0	0	0	0	0	0	0	0	0	0	9079	55069	0
(122.7)	76	0	0	0	0	0	0	0	0	34039	4116	45839	5689	0
(53.8)	77	0	0	0	0	0	0	0	0	0	0	0	0	0
(104.7)	78	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	859	3896	6913	13979	11634	0
Maximum									42958	58128	67943	70918	78978	0
Spills in excess of 44 kcfs									0	2	2	9	6	0
cap														

Table A-23. Simulated involuntary spills at The Dalles Dam under the reference operation and the frequency that those spills would exceed the 135 kcfs spill cap. Source: Raw data, BPA HYDSIM model run FRIII_USNBIOP04.xls, Spill cap exceedence analysis, NMFS staff.

Reference Operation

365 DALLES

0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(68.9)	29	0	0	0	0	0	0	0	0	0	0	0	0	0
(70.2)	30	0	0	0	0	0	0	0	0	0	0	0	0	0
(64.5)	31	0	0	0	0	0	0	0	0	0	0	0	0	0
(106.7)	32	0	0	0	0	0	0	0	0	21531	69220	71370	35108	0
(108.4)	33	0	0	0	0	0	0	0	0	0	0	0	146737	40569
(110.6)	34	0	0	0	0	0	15775	76532	10528	0	38413	61586	16002	0
(91.0)	35	0	0	0	0	0	0	0	0	0	0	0	0	0
(89.5)	36	0	0	0	0	0	0	0	0	0	0	97170	0	0
(69.4)	37	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	38	0	0	0	0	0	0	0	0	0	9571	83746	30888	0
(81.3)	39	0	0	0	0	0	0	0	0	0	0	0	0	0
(81.7)	40	0	0	0	0	0	0	0	0	0	0	0	0	0
(69.9)	41	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	42	0	0	0	0	0	0	0	0	0	0	0	21648	0
(118.5)	43	0	0	0	0	0	0	0	0	88770	96028	73296	63127	0
(60.3)	44	0	0	0	0	0	0	0	0	0	0	0	0	0
(83.3)	45	0	0	0	0	0	0	0	0	0	0	0	9551	0
(111.8)	46	0	0	0	0	0	0	0	0	0	36343	95254	18110	0
(106.7)	47	0	0	0	0	0	0	0	0	0	0	64038	10038	0
(131.4)	48	0	0	0	0	0	0	0	0	0	18484	118522	366407	2727
(102.5)	49	0	0	0	0	0	0	0	0	0	51683	107048	18387	0
(124.9)	50	0	0	0	0	0	0	0	0	0	20764	45527	185083	22955
(125.0)	51	0	0	0	0	0	3330	23535	0	9457	57724	129017	11083	0
(113.5)	52	0	0	0	0	0	0	0	0	42983	85496	154116	17251	0
(106.8)	53	0	0	0	0	0	0	0	0	0	0	13533	113320	0
(118.3)	54	0	0	0	0	0	0	0	0	0	0	67418	123333	12626
(96.9)	55	0	0	0	0	0	0	0	0	0	0	0	131950	53122
(141.0)	56	0	0	0	0	0	26640	0	0	26308	132972	201584	189378	0
(112.7)	57	0	0	0	0	0	0	0	0	912	0	137806	135469	0
(107.6)	58	0	0	0	0	0	0	0	0	0	28801	106500	57548	0

Reference Operation

365 DALLES

0 FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(118.8)	59	0	0	0	0	0	7555	0	0	0	0	34861	108964	17760
(102.5)	60	0	0	0	0	0	0	0	0	56244	29864	0	15434	0
(111.4)	61	0	0	0	0	0	0	0	0	0	0	10336	154653	0
(97.2)	62	0	0	0	0	0	0	0	0	4426	51458	19567	6718	0
(94.7)	63	0	0	0	0	0	0	0	0	0	0	3532	0	0
(107.3)	64	0	0	0	0	0	0	0	0	0	0	0	164842	26972
(126.1)	65	0	0	0	0	0	30327	4883	0	0	62994	90791	99585	0
(89.3)	66	0	0	0	0	0	0	0	0	0	0	0	0	0
(113.7)	67	0	0	0	0	0	0	0	0	0	0	0	160646	18584
(95.5)	68	0	0	0	0	0	0	0	0	0	0	0	0	15427
(122.4)	69	0	0	0	0	0	0	0	0	72937	85050	161460	37606	0
(90.0)	70	0	0	0	0	0	0	0	0	0	0	6522	81728	0
(138.9)	71	0	0	0	0	0	0	15238	0	0	22138	205694	169475	0
(152.5)	72	0	0	0	0	0	0	0	93223	74508	0	168984	266420	29315
(71.2)	73	0	0	0	0	0	0	0	0	0	0	0	0	0
(156.9)	74	0	0	0	0	0	83968	23402	0	45998	98795	149375	257502	66632
(111.9)	75	0	0	0	0	0	0	0	0	0	0	45247	130223	38689
(122.7)	76	0	0	0	0	0	0	0	0	47348	26528	143516	18513	12726
(53.8)	77	0	0	0	0	0	0	0	0	0	0	0	0	0
(104.7)	78	0	0	0	0	0	0	0	0	0	0	31261	12605	0
Average	0	0	0	0	0	315	4567	1552	1864	10597	20910	53062	67695	6854
Maximum	0	0	0	0	0	15775	83968	23535	93223	88770	132972	205694	366407	66632
Spills in excess of the 135 kcfs cap	0	8	11	0										

Table A-24. Simulated involuntary spills at The Dalles Dam under the proposed action and the frequency that those spills would exceed the 135 kcfs spill cap. Source: Raw data, BPA HYDSIM model run FRIII_USNBIOP04.xls, Spill cap exceedence analysis, NMFS staff.

Proposed Action

365 DALLES

	FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(68.9)	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(70.2)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(64.5)	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(106.7)	32	0	0	0	0	0	0	0	0	0	0	57522	46446	19899	0
(108.4)	33	0	0	0	0	0	0	0	0	0	0	0	0	133555	45090
(110.6)	34	0	0	0	0	0	10280	70889	4756	0	34527	57700	13926	0	0
(91.0)	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(89.5)	36	0	0	0	0	0	0	0	0	0	0	0	65852	0	0
(69.4)	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	38	0	0	0	0	0	0	0	0	0	0	918	64149	14930	0
(81.3)	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(81.7)	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(69.9)	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(91.0)	42	0	0	0	0	0	0	0	0	0	0	0	0	13467	0
(118.5)	43	0	0	0	0	0	0	0	0	0	81208	88466	55135	40806	0
(60.3)	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(83.3)	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(111.8)	46	0	0	0	0	0	0	0	0	0	0	29744	80002	10261	0
(106.7)	47	0	0	0	0	0	0	0	0	0	0	0	49142	2135	0
(131.4)	48	0	0	0	0	0	0	0	0	0	0	11829	105739	358305	3232
(102.5)	49	0	0	0	0	0	0	0	0	0	0	39766	93399	14826	0
(124.9)	50	0	0	0	0	0	0	0	0	0	0	16212	32448	165498	22387
(125.0)	51	0	0	0	0	0	0	9412	19763	0	2648	50915	109333	49	0
(113.5)	52	0	0	0	0	0	0	0	0	0	35330	77843	131832	8425	0
(106.8)	53	0	0	0	0	0	0	0	0	0	0	0	9709	96963	0
(118.3)	54	0	0	0	0	0	0	0	0	0	0	0	53688	117806	12626
(96.9)	55	0	0	0	0	0	0	0	0	0	0	0	0	125199	53411
(141.0)	56	0	0	0	0	0	0	25109	0	0	23500	130164	176282	172780	0
(112.7)	57	0	0	0	0	0	0	0	0	0	1556	0	121154	119725	0
(107.6)	58	0	0	0	0	0	0	0	0	0	0	25708	88990	52781	0
(118.8)	59	0	0	0	0	0	0	1135	0	0	0	0	26487	102495	22814
(102.5)	60	0	0	0	0	0	0	0	0	0	51686	25306	0	15444	0

Proposed Action

365 DALLES

FORCED	AUG1	AUG2	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR1	APR2	MAY	JUN	JUL
(111.4)	61	0	0	0	0	0	0	0	0	0	0	5746	154000	0
(97.2)	62	0	0	0	0	0	0	0	0	0	43888	3498	0	0
(94.7)	63	0	0	0	0	0	0	0	0	0	0	0	0	0
(107.3)	64	0	0	0	0	0	0	0	0	0	0	0	151872	27880
(126.1)	65	0	0	0	0	0	32183	8285	0	0	59607	72106	75563	0
(89.3)	66	0	0	0	0	0	0	0	0	0	0	0	0	0
(113.7)	67	0	0	0	0	0	0	0	0	0	0	0	143546	18584
(95.5)	68	0	0	0	0	0	0	0	0	0	0	0	6181	0
(122.4)	69	0	0	0	0	0	0	0	0	59065	71178	148071	33133	0
(90.0)	70	0	0	0	0	0	0	0	0	0	0	0	63877	0
(138.9)	71	0	0	0	0	0	0	23927	0	0	23861	182900	140840	0
(152.5)	72	0	0	0	0	0	0	0	95310	71189	0	151180	242622	29315
(71.2)	73	0	0	0	0	0	0	0	0	0	0	0	0	0
(156.9)	74	0	0	0	0	0	87901	31244	0	48087	100884	132060	227577	68066
(111.9)	75	0	0	0	0	0	0	0	0	0	0	0	34656	106187
(122.7)	76	0	0	0	0	0	0	0	0	45507	24687	122059	9145	12726
(53.8)	77	1524	0	0	0	0	0	0	0	0	0	0	0	0
(104.7)	78	0	0	0	0	0	0	0	0	0	0	14260	0	0
Average	30	0	0	0	0	206	4533	1759	1906	9086	18724	43805	58798	7052
Maximum	1524	0	0	0	0	10280	87901	31244	95310	81208	130164	182900	358305	68066
Spills in excess of the 135 kcfs cap		0	4	9	0									